

THE MODEL ENGINEER



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The MODEL ENGINEER

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S M O K E R I N G S

Our Cover Picture

● THIS WEEK we have used a very fine photograph of a train of spur gears, to symbolise the craftsmanship of the engineer. From the time when the oxen plodded in an unending circle, operating crude gears constructed of wood to draw water from the wells of Asia, to the hypoid gearing of today, the history of gears would fill many volumes, and their development and use has now reached a point where we find them in almost every machine coming within the classification of engineering.

My Thanks for Cheerful Greetings

● MY BEST thanks to the many readers at home and overseas who have kindly sent cards of good wishes for the recent festive season and the New Year. A particularly clever and amusing card reached Mr. Westbury from Col. N. MacNeill of Dublin. Very artistically drawn and coloured, it depicts a chef at a milling machine on the table of which is a fat turkey awaiting its fate from the teeth of an aggressive-looking circular saw! I do not know whether this indicated the mechanical inclinations of the chef in question, or whether it was a recognition of the super-toughness of the turkey. But, either way, it is good to know that at least one reader got an appropriate Christmas dinner!

The Oldest Model Club

● WHICH IS the oldest model club in this country? I ask this question because I am reminded that the Tynemouth Model Yacht Club, which caters for both sail and power craft, was established as long ago as 1893, five years before the birth of THE MODEL ENGINEER and the Society of Model and Experimental Engineers. I think it probable that some of the purely sailing clubs can go back as far as this or even to an earlier date, but I do not know of any model engineering or power boat club which can trace a prior history.

"Give it the Works"

● WHILE I was writing my recent "Smoke Ring" on the modern craze for speed a letter was on its way to me from Mr. V. H. Messer of South Australia. The letter is now to hand and in it he tells me the following little story illustrative of the mind of the rising generation. He writes:—"It seems a great pity that the trend of model engineering today seems to be for speed—and more speed I supposed you have noticed this. Here's an example. At our recent exhibition I showed my overtype steam engine (Budd's fine design) turning over at a slow yet scale number of revs. A younger member looking on remarked 'Is that the best it can do? Give

it the works!' Well, sir, I ask you!" I think Mr. Messer will read my recent observations on this subject with some interest.

Making Old-time Models

● HERE ARE some worthwhile thoughts on the value of models of old-time prototypes. I quote them from a Christmas message to designers from that bright little magazine *Modelcraft*. "Another aspect of modelmaking is the link it provides both with the past and the future. We are believers in progress but we know that the past is indivisibly linked with the future; only from the past can be garnered the lessons of experience which are the guide to the future. So the past should not be ignored and, in recording some of the past in your plans, you are doing useful work. It is, too, pleasant to think that your work will carry on into the future. To give but one example—we are quite sure there will be as much demand for plans of the *Cutty Sark* fifty years hence as there is now and, fifty years hence, they will be more valuable, for that fine old ship will probably have gone to her last resting place and our plans will be one of the few existing links with that era. The stage coach has gone, the windmills are fast disappearing, every day a few more trams come off the road. Other things take their places. Let us try to record them all, for in this recording of the past and present in model form we are performing a useful service. Many of our designs of the distant past are admittedly not authentic, for no data exist and we can only base our calculations on records of contemporary work. When one considers that of such an important vessel in the history of this country as the *Golden Hind* not a single authentic record now exists, one realises how much can be lost to posterity and how the multiplication of records by means of models and model plans removes this risk to a considerable extent."

Progress at Portsmouth

● I AM glad to hear from Mr. Handsford that the Portsmouth Society can report a successful year for 1947, and an ever-growing membership. An interesting piece of news is that through the generosity of Mr. W. K. Tate, the General Manager of the Portsmouth and Gosport Gas Company, a site on the Company's sports ground has been allotted for the erection of club rooms and workshops for the Society. Plans are being prepared by an architect member Mr. H. Dyer, and the Treasurer, Commander L. A. Brown, is making it possible for suitable huts to be obtained and in many other ways is rendering valuable assistance to the Society. Portsmouth is fortunate in having these helpful enthusiasts in its membership, and I would like cordially to reciprocate the good wishes which the Society now sends me.

Those Were the Days

● FRIEND S. W. SIMPSON of Brentwood sends me a reminder of the good old days when THE MODEL ENGINEER was beginning to grow up. It is a slip of paper attached to one of our early issues announcing that in the future THE MODEL

ENGINEER would be published twice each month, and that the price would remain at 2d. per issue, post free 3d. Mr. Simpson says:—"It takes us back a long way—those were the days." Yes, indeed, the days when 2d. really meant 2d. and when life moved at a leisurely and dependable pace are now only a memory, but a pleasant memory in the history of THE MODEL ENGINEER. As the founder of that most hospitable function known to London model engineers as "Simpson's Day," Mr. and Mrs. Simpson have done much to stimulate the brotherhood of the hobby and to add to the many memories of good friends and pleasant moments which have been milestones along our fifty years of travel.

Exports to Canada

● RECENT RESTRICTIONS on the export of goods to Canada from the U.S.A. imply a considerable expansion of the Canadian market for British manufacturers. Here is a letter from Mr. John P. Bowen of Canada Models, 17, South Market Street, Brantford, Canada, which explains the situation. Mr. Bowen came to see us last summer and discussed his plans for developing export trade in model supplies and workshop equipment. He has an excellent organisation for the purpose, and as he contemplates another visit to this country early this year, he would be glad to contact British firms who are looking for a Canadian market; and he would appreciate advance information as to goods which are likely to be available. This is what he says:—"Due to a combination of reasons, both private and business, I will soon be making another trip to England. I want to contact as many firms as possible who are interested in exporting to the U.S.A. and Canada. I am not only interested in models but in machine tools, wood-working machinery, and a host of lines. As you know, I have had considerable experience in the Canadian and American markets as regards model and hobby supplies. I will have reports from dealers of both countries giving me their ideas of the goods they can handle. The recent import restrictions placed on the Canadian importer of model and hobby supplies have a great bearing upon U.S.A. imports, and offer a great opportunity to the British manufacturer to capture a very lucrative Canadian market, provided that he can get and make use of a proper advisory service as regards his product. Here is where the definite need of an 'Export Group' arises. I want to say that I stand ready to offer my services to this group wholeheartedly, as soon as I arrive in London, which should be some time in February or early March of this year. I sincerely believe that I am in a position to help in a great many ways to acquaint the British manufacturer with the needs and pitfalls of the dollar area market, which, I think you will agree, I know so well."

Percival Hannay

A Showman's Road Loco.

Built by J. S. Harwood and described by W. J. Hughes

THROUGHOUT his working life of more than thirty years, J. S. Harwood has been an engineer by profession; he is now chief engineer to a large firm in Sheffield. Yet, as he says, he still finds that the best relaxation from engineering is *model engineering*. Perhaps it is that the problems and distractions at the works may be solved quite often while some problem of the home work-

finished in April, 1939, and on the outbreak of war, it and its showcase were screwed up in a very strong specially-made box, and placed under the work bench, so that, should the house receive a direct hit, as so many did in Sheffield, it should be possible to salvage the model. Fortunately, however, this was not necessary.

The engine is more a representational show-

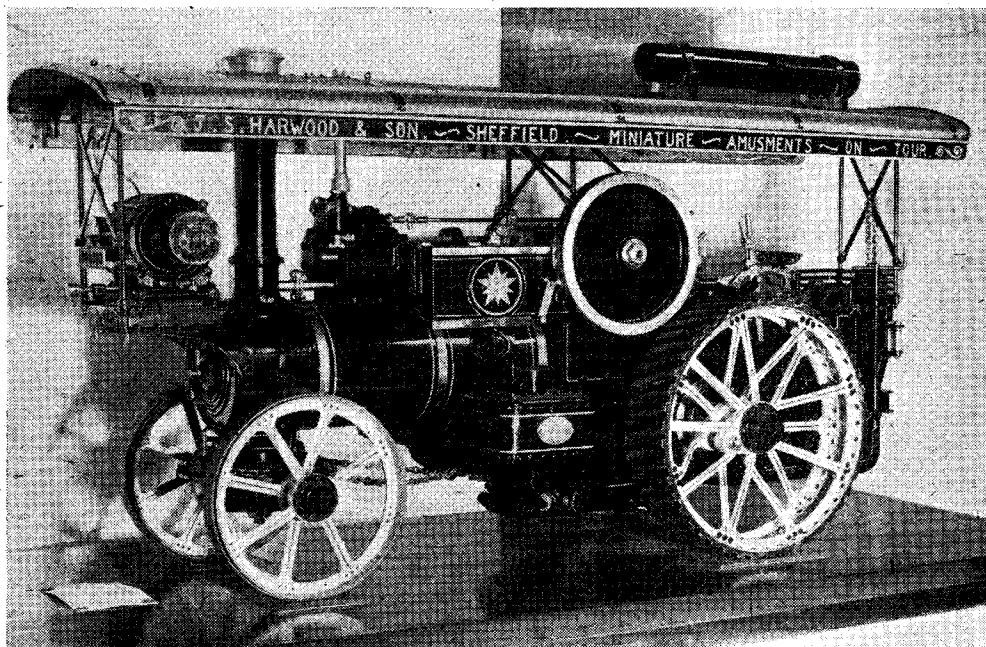


Photo No. 1. A fine showman's engine which was awarded a first prize at the 1947 exhibition of the Sheffield S.M.E.E.

shop is being worked out; or is it that at home the pace is one's own?

Whatever the reason, the hours that Mr. Harwood passes in his workshop are profitably and happily spent. The chief machine-tool is a 4½-in. Britannia lathe (type F.I.), with a hand-shaper and small drilling-machine, and, of course, a large number of hand tools. The workshop is a cellar, which was dug by Mr. Harwood himself, by the way.

The 1½ in. scale model here described was begun in order to satisfy a long-standing desire to build a road locomotive, and is one of a list of models which the builder keeps in mind as projects which must be built sooner or later. A diary of progress was kept, and it is interesting to note that some 1,300 hours of spare time, spread over 1½ years, were spent in its construction. It was

man's engine than a model of any particular prototype, but is very similar in outline and arrangement to the Fowler "Lion." The chief construction was from Henry Greenly's drawings; but many hours were spent on fairgrounds measuring up and sketching details to ensure that the locomotive would be a good representation of the real thing. The accompanying photographs show to what extent the objective has been achieved.

Note, for example, the details of the driver's cab. There are the usual pressure-gauge and water-gauge, reversing-lever, fire-door and so on; but the driver's seat, coal-rails, number-plates, rear-light, and other fittings add much to the realism of the model. Incidentally, the builder doubts whether the coal-rails actually were featured in the Fowler "Lion," but could not

resist the temptation to fit them, to gain realism.

Most showmen's engines are compound, but Mr. Harwood is dubious as to the value of compounding, unless the initial pressure is over 100 lb. per sq. in., so his engine is built with a single cylinder of 1 in. bore by $1\frac{1}{2}$ in. stroke. The valve-gear is Stephenson's link-motion; the curved links are not slotted through, but are milled channel-section from the solid. The reversing-lever may be seen on photograph 1 just above the rear wheel. The displacement lubricator may be seen on photographs 1 and 3, just in front of and above the cylinder.

The boiler is coal-fired, and has five $\frac{5}{16}$ -in. tubes only, which were all that were shown on the Greenly drawings, but the builder says that had he read, marked, learned, and inwardly digested "L.B.S.C.'s" articles as thoroughly in those days as he now has, the tubes would have been smaller in diameter and more in number. The boiler is of copper, lagged with asbestos, and covered with a thin brass cladding. An inspection manhole is fitted, which may be seen on the nearside, just below the motion cover (photograph 1).

A water-tank is fitted in the cab, and is connected to the belly-tank, under the boiler, by means of a $\frac{1}{16}$ -in. pipe. This has correct square flanges to affix it to the tanks, and has a screw-down stop-valve, behind which is fitted a sliding expansion joint to allow for expansion of the boiler. These features are seen again in photograph 1, just in

front of the rear wheel, the expansion joint being just behind the wheel-valve. The tanks are riveted-up from copper, and then silver-soldered for strength and watertightness. Correctly-shaped filler-caps are fitted, with two strap-hinges and screw-down fastener. Access to that in the cab is obtained by hinging the driving-seat backwards, as on the prototype.

The seat was beaten to shape from copper sheet on a wooden former, and fretted out with a jeweller's piercing-saw. In addition to being hinged, as mentioned above, it is sprung on a single spring-leaf, and adjustable both for height and in the forward direction. It can be seen in all the photographs. In passing, it may be remarked how extremely comfortable were these seats, correctly shaped to one's anatomy!

Eight spokes are fitted to the front wheels, and sixteen to the rear ones. The rims were turned from steel rings, the angles being integral, and the hubs are built-up, with the spokes fastened by screws in grooves milled across the ends of the centre-section, and concealed by end-caps. The driving-pins of the rear-wheels are held in place with specially-made flat-section split-pins. Forty-five cross-strakes, held by four rivets each, are fitted to each rear-wheel, and three circumferential strakes to each front wheel.

There are two speeds and free-running position, operated by a lever in the cab, which is visible in the "close-up" photograph, just behind the valve-lever. A winding-drum is fitted

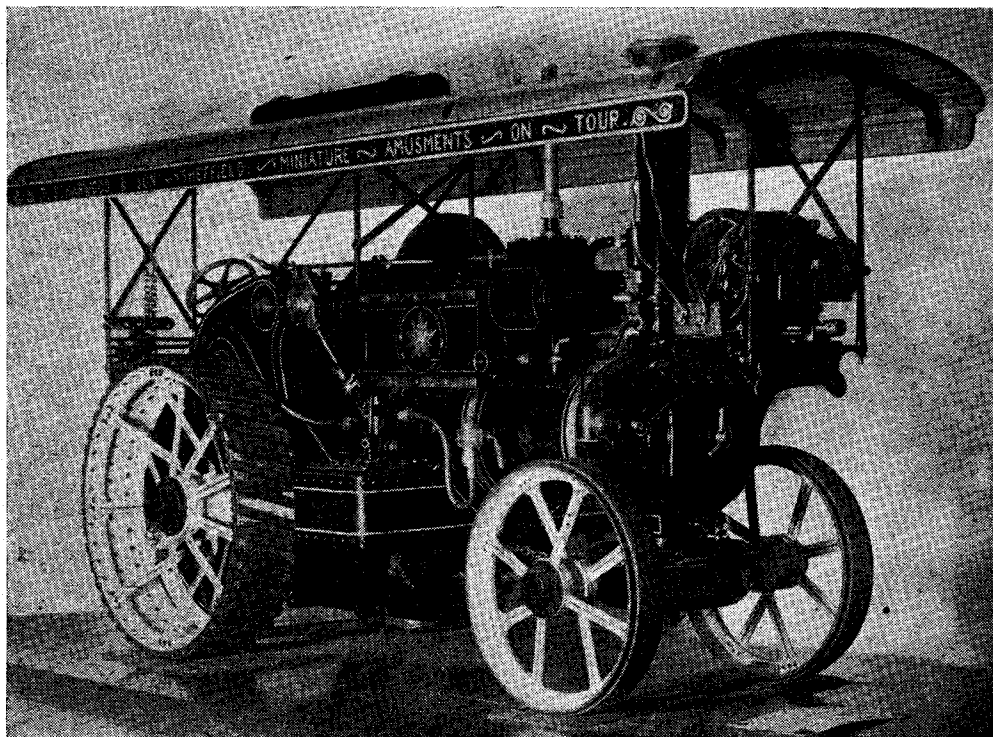


Photo No. 2. An imposing model! Note the fine detail work, including side-lamp and number-plate

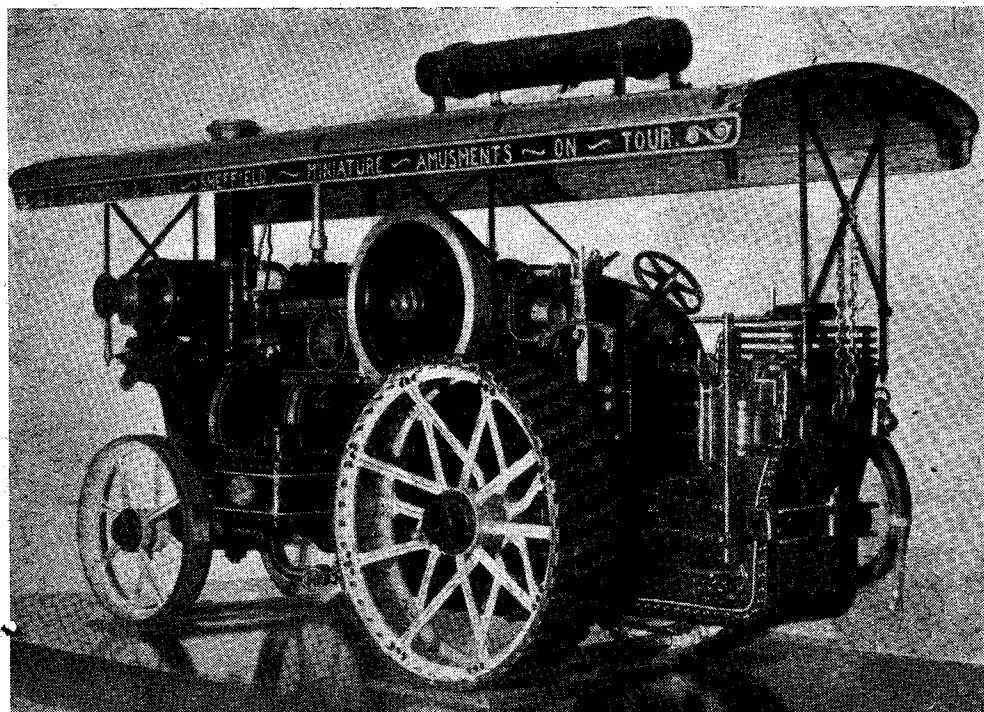


Photo No. 3. The displacement lubricator is in direct line with chimney. Valve controlling flow between tanks is just in front of rear wheel

behind the near-side rear-wheel, and there are steel roller-type cable-guides fitted to the cab-side, one in the horizontal plane behind the wheel, and two in the vertical plane at the rear corner of the cab, also visible in the "close-up."

Referring again to the latter, the other lever seen between the gear-change lever and the steering wheel is that controlling the throttle, which is in the valve-chest. Immediately below it, visible through the entrance to the cab, is the water-gauge, which is on "stalks" to clear one of the gear-shafts. The steering-wheel was turned from the solid, with the spokes fret-sawn and filed to shape. Immediately below it may be seen the handle which operates the ash-pan damper, and on the near side of the cab, just behind the entrance-opening, the hand-brake handle. Note also the chequered foot-steps, one riveted to the tank manhole cover, under the brake operating-beam, and the other to the cab-side, level with the entrance.

The number-plates and name-plate "Peter-kin" were made by fretting out the letters, numbers, and surrounds separately from sheet-nickel, and these were soft-soldered to their back-plates. Side-lamps (only one of which was mounted when the pictures were taken) and rear-lamp are built-up by silver-soldering; the lenses are ground down from glass marbles which acted as stoppers in the old-fashioned "pop" bottles—do you remember them? An alternative source of supply would have to be sought nowadays! The lamps have oil-containers and

wicks, which will burn perfectly with the container *outside* the body of the lamp. However, since one "can't scale Nature" (where *have* I heard that phrase before?), the tiny scale-size air-holes will not pass sufficient air to support combustion, and the flame goes out when the container is put in its rightful place.

Steering is by the usual worm-and-wheel and chain. The steering chain, and the towing chain, were hand-made as follow. Suitable nickel-silver wire was wound several turns round an oval nail of suitable size, and a saw-cut was made lengthwise along the nail, to separate the links. A pair of links having been put together, the joints were silver-soldered, the operation being repeated several times. The pairs of links were now joined by single links to form sets of five, which were again joined to make sets of eleven, and so on, until the requisite length was achieved.

Of course, no showman's engine would be complete without a dynamo. In this case, the working parts of a cycle dynamo were "dressed up" with thin end-plates which had feet formed in, and these were bolted down to a platform having a screw-device for belt-tensioning, which the builder favoured as against the alternative method of slide-rail adjustment (both methods are used on prototype engines). The screw may be seen between front number-plate and name-plate. The knurled wheel which normally runs on the cycle-tyre was annealed, turned down, and fitted inside the crowned and flanged pulley seen in the photographs, which was easier to do than

to bore an internal taper in the latter to fit the taper of the armature shaft.

Mr. Harwood has an inherent objection to the twisted brass columns which frequently support the canopies of showmen's engines (I like them myself!), and on his model he has copied accurately the plain supports actually seen on an engine in a Sheffield fairground. The canopy itself is a thin sheet of oak, vee-grooved under-

tioned. While the tanks are being replenished, pressure-feed to the boiler may be shut off by a cock between clack and boiler. All these points may be seen on photograph 2, but unfortunately what does not show is a beautiful little strainer fitted to the receiving end of the hose, to keep out frogs, newts, and "tiddlers" when filling up from a ditch or pond. An emergency hand-pump is fitted to the rear-tank.

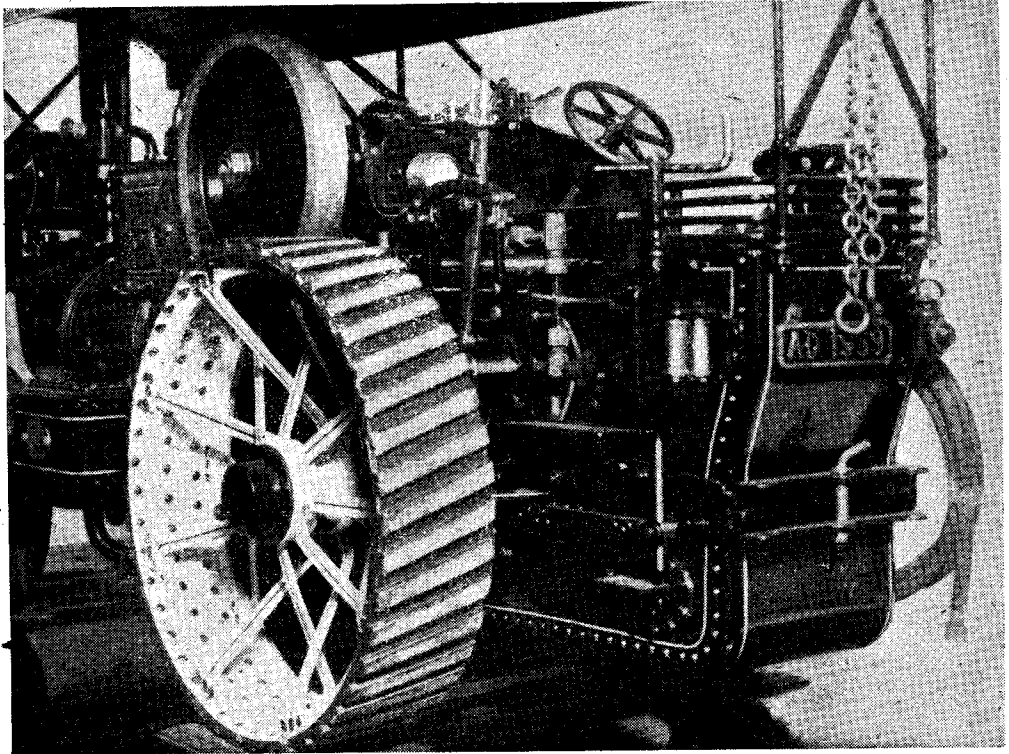


Photo No. 4. "Close-up"—A more detailed rear view. Note haulage-chain, number-plate, rear-lamp, rope-guides, etc.

neath to represent oak match-boarding, and bolted down to the curved angle-iron supports underneath. It is covered with "roofing-felt," held down with cleading-straps, and fitted with rain-water deflecting-strips. As will be seen, the extension chimney is mounted on top; visible in photographs 1 and 2 are the small eye-bolts to which the wire stays of the extension chimney are fastened when it is erected. The woodwork is cut away around the chimney and the safety-valve extension, as in the prototype, to obviate the dangers of overheating, the gaps being filled by sheet-metal bolted to the canopy.

A water-pump is mounted on the off-side of the engine, driven by an eccentric on the crankshaft. It connects with the rear-tank on the suction side, and on the pressure-side with a clack on the boiler-barrel. There is also a suction connection to which the rubber hose may be coupled, with a pressure connection to the belly-tank, from which the pumped-in water may flow to the rear-tank, via the wheel-valve and pipe previously men-

tioned. Sheet-copper was used to build the cab because of the flanging required, and, after riveting, was silver-soldered, the tank being built in. The drag-beam, which extends forward to the horn-plates, and through which the towing-pin passes, is made from steel, however.

The engine was painted by the builder, entirely by hand. Smokebox, chimney, and firebox are black, with maroon boiler and cab, on which the lining is black and yellow. The wheels are primrose yellow, with a thin red line on each spoke, and rivet-heads picked out in red. All lining was done with a fine brush made even finer by having most of its bristles cut away. Chimney-cap, safety-valve extension-tube, boiler-bands, and decoration on motion-covers are of polished brass, with a small brass plate on the near-side of the belly-tank engraved with the maker's name. The flywheel rim, gear-lever, and sundry other working parts are polished steel. Altogether, the engine presents a sight which gives me, at any rate, a nostalgia for boyhood days, when I used to hang

around the back scenes of the local "Feast," watching these beautiful giants purring away at their appointed task, seeming to be living, breathing, sentient beings. It is sad to think that, in the name of economy, they are now almost extinct, replaced by racketty monstrosities with no soul and certainly with no aesthetic qualities worthy of a self-respecting model engineer. Ah me! the combined scent of steam, oil, and coal-smoke that greeted the nostrils—the incomparable glory if the Jove-like attendant allowed one to put a knob or two of coal on the fire! Sad indeed that the lads of today can only know the reek of exhaust gas and an unappeased numbing roar. Even the mellow tooting of roundabout steam organs has gone, replaced by the over-amplified adenoidal bleating of some love-sick crooner. Progress? Maybe—but one wonders what today's boyhood will have to say about the fairgrounds of twenty years hence. Will they be sighing for the exhaust fumes of the "good old-fashioned diesels" of their youth, replaced by some atomic-powered engine about the size of a tea-cup, which doesn't even produce *any* kind of odour? Verily, one generation's meat is the next one's poison!

However, let us come back to the present, and the more immediate future. Like myself, Mr. Harwood likes to have two or three jobs "on the go" at once—then if one feels "browned-off" with one, there's another waiting. To some of the fraternity, we know, this would be abhorrent; but it's the way *we* work, and *we* like it, so what?

At present, therefore, he has in hand a 5-ft. cabin-cruiser, a 4 $\frac{3}{4}$ -in. gauge tank locomotive

based on an L.M.S. design, and a very large American-type 3 $\frac{1}{2}$ -in. gauge locomotive—a free-lance 2-10-4 with 12-wheeled tender, which seems to be built by the yard! This engine has bar-frames cut from steel $\frac{3}{4}$ in. thick, Baker valve-gear, and several highly original ideas which we think will be unique and of great interest to others—but that will be another story, with the Editor's permission. Oh yes! and I mustn't forget that in addition to these, Mr. Harwood has found time to design and build the Equatorial Mounting for an Astronomical Telescope, which was illustrated (along with the road locomotive) in *THE MODEL ENGINEER* for May 22nd, 1947, and was awarded a Special Prize at the 1947 Exhibition in Sheffield. It has also been of great interest to the Sheffield Astronomical Society. I hope to describe and further illustrate this beautiful piece of work in a future issue of *THE MODEL ENGINEER*.

Incidentally, I asked Mr. Harwood if he had any especial difficulties in building the Showman's Engine, to which his reply was "No, Bill, not particularly. But I find that what tries my patience most, and requires perseverance of no mean order is that in building *any* model it almost invariably has to be assembled and dismantled so many times—and no amount of previous planning seems to ease this situation."

Nevertheless, it appears to me that this particular model engineer has the necessary patience and perseverance to overcome *any* difficulty he may encounter, large or small—and I think other members of the Sheffield S.M.E.E. would endorse that remark!

Mandrel Adaptor for Drilling Machine

by "The Leveret"

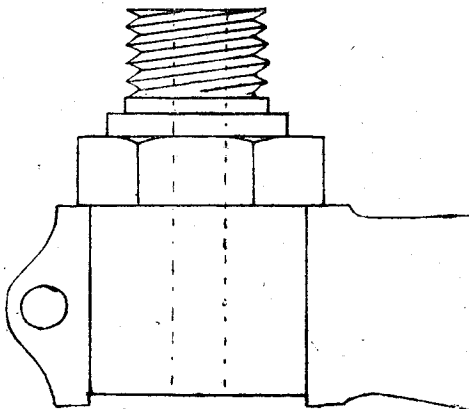
THIS simple fitting is turned from hexagonal bar, threaded and finished at one end similar to mandrel nose. The other end is turned parallel to suit the clamp which takes the boss of a rotating drilling-machine table. If round bar is used, two flats or a hexagon should be formed on the centre portion in order to remove the adaptor should it become tightly screwed into the chuck backplate, or faceplate with which it may also be used. The adaptor is bored right through to the same diameter as the bore of the hollow mandrel of the lathe.

If the drilling machine is large—the writer's machine is a Kerry "Super" with a clamp

to take 1 $\frac{3}{16}$ -in. diameter—the outside of the back-plate or faceplate boss can be machined to fit the table clamp. It should be fairly accurately set up in the lathe to ensure concentricity with

the internal thread and register. Take care that such machining be not taken so far along the boss that bolt-heads at the back of the plate strike the table arm when rotated.

With the aid of this adaptor alternate drilling and turning may be carried out without disturbing the setting of the work-piece. Milling slides, machine vices, etc., may be fitted to chuck back-plates, suitably turned on the boss, and be instantly interchangeable with the table.



Home-made Lathe Countershaft

by A. G. Welch

THIS countershaft was the outcome of much thought on the problems involved by a short flat belt drive. Continued tightening and breakage of belt, with consequent uneven strain on headstock bearings, made it imperative to change to "V" drive. This entailed discarding the "flat"

countershaft, with its very useful fast and loose pulleys. The ability to stop the lathe without switching off the motor each time was considered essential; also, belt shifting must be easily accomplished, and nothing done to interfere with back gear drive. This indeed appeared a formidable task, but after several rough sketches and a few "brainstorms," the present countershaft evolved.

A pair of four-step pulleys was purchased, and bored to $\frac{1}{4}$ in. It was then noticed that the back gear pinion was integral with the flat pulley on headstock. This almost caused a breakdown in operations—how to fix a pinion to the "V" pulley? Searching through our ever-present help in trouble—the junk box—a small gear was discovered with the correct number of teeth, and the right size, approximately $\frac{1}{4}$ -in. bore, with a wide flange on one end. This then had to be utilised somehow. As it was hardened, it was necessary to anneal it by heating it up and allowing it to cool slowly. The bore was then opened up to $\frac{3}{4}$ in. and the flange turned to $\frac{1}{4}$ in. thick, after which it was carefully clamped to small end of "V" pulley, and holes drilled through flange and pulley, the two being finally riveted together with countersunk rivets.

On the original flat pulleys, drive was trans-

mitted to the mandrel through the gear "A" (see photograph), this having a small bolt screwing through the gear into the pulley. Snag number two now arose—how to get a good direct drive from pulley to mandrel?—as it was felt there was not enough "meat" on the edge of the

"V" pulley to take a bolt. This difficulty was overcome by fitting a small grub-screw of the Allen type through the bottom of the "V" pulley and engaging in a small countersink in lathe mandrel, the original driving bolt now being discarded. All that is necessary, when engaging back gear, is to slacken off this grub-screw, leaving the "V" pulley free to revolve.

The construction of the motor mounting frame and top pulley mounting was a straightforward job. Two pieces of old bedstead angle-iron form the main frame ("B" in photograph). On each of these was mounted the plummer block supports. These were of 1-in. angle-iron, and were cut and bent to shape in the vice, and welded at a local garage.

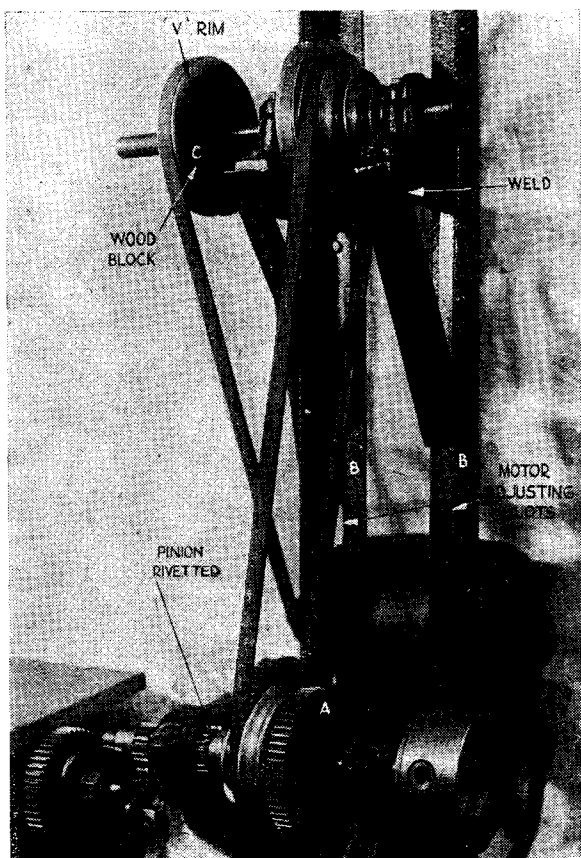
The plummer blocks were already to hand, and simply needed lining up on support and bolting down.

It may be observed that the headstock pulley has only three steps, and the top pulley four. As purchased, both had four steps, but it was found that the largest size just would not go between the mandrel and the gap in the headstock casting, so the largest step was carefully sawn off, and a block of hardwood turned to a tight fit in the V "rim" removed from the pulley. This has been utilised



"Free" position

to take the drive from motor to countershaft, as shown at "C," and can plainly be seen in photograph. Holes were drilled in the main frame "B" for motor mounting, and elongated to form adjustment slots for the motor if and when necessary, by slackening nuts and sliding motor up or down. At bottom of each support "B," an ordinary butt hinge was bolted, and this screwed to the bench top. The whole countershaft was now free to swing easily backwards and forwards, thus providing tension adjustment to mandrel drive. By mounting the motor fairly low down, it was found to balance nicely and needed only light pressure to shift for "stop" or "start," also, the weight of the motor keeps the whole thing rock-steady, and is sufficient to keep the lathe running even under a fairly heavy cut.



Driving position

The countershaft has been running now for about twelve months, and has given complete satisfaction, running freely and almost noiselessly. The whole thing has been given a coat of green "Enamelit," which helps to brighten the shed — i.e. "workshop."

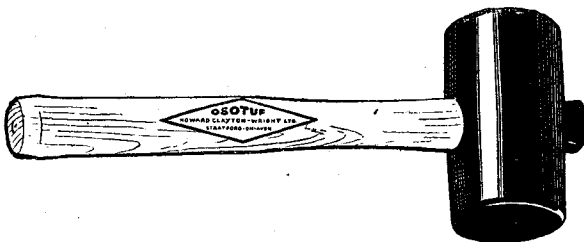
Of course, something similar might have been purchased, and saved a lot of valuable time, but there is a feeling of deep satisfaction when something home-made works efficiently—even if unorthodox in design! I trust that more experienced mechanics will overlook any shortcomings, as I am just a common printer by trade.

Incidentally, the photographs (taken by the writer) proved a little difficult to get in the confined space of a shed about 6 ft. wide, but I trust they will give a clear idea of the finished countershaft.

Plastic-Headed Mallets

WHEREVER it is necessary to deliver a solid blow without risk of injury to finished surfaces, a mallet having a head or insert of resilient material is extremely useful, and much preferable to the old wood mallets, lead hammers or copper drifts formerly used. Our attention has recently been drawn to the "Osotuf" mallet produced by Messrs. Howard Clayton - Wright Ltd., Tiddington Road, Stratford-on-Avon, which has a solid moulded hard rubber head, mounted on a hardwood shaft, and is made in two weights

(A) 12½ oz. and (B) 32 oz. respectively. In addition to the solid-headed mallet, combined hammer-mallets are available, having either metal and rubber faces on the two ends of the head, or two rubber faces of different hardness, which are in either case readily renewable, being made in the form of thick rubber caps pressed on to corrugated steel spigots, which in turn are mounted on hickory shafts. These tools are made in weights of 1½ and 2½ lb., and will be found extremely valuable in many branches of engineering.



A Simple D.C. Magnetiser

by "B. H. Max"

HAVING decided that an electro-magnet capable of magnetising *in situ* the incorporated permanent magnets of small motors, magnetos and the like, would be a useful and interesting addition to the workshop, the possibility of constructing this in a simple and inexpensive form was considered. It had to operate from 230 v. a.c. mains, preferably without the use of a step-down transformer. After preliminary discussion with a firm already using such a magnetiser, the following design was adopted

Core.	Ordinary commercial mild-steel	
2½ in. diameter	£1
Limbs.	Ordinary commercial mild-steel	
2½ in. square section	£1
Rectifier.	Selenium type. Input 230 v. a.c.	
Output 170/180 v. d.c., 2½ amps.	£5
Switch.	Ordinary spring-loaded type, inserted on the a.c. side 5s.

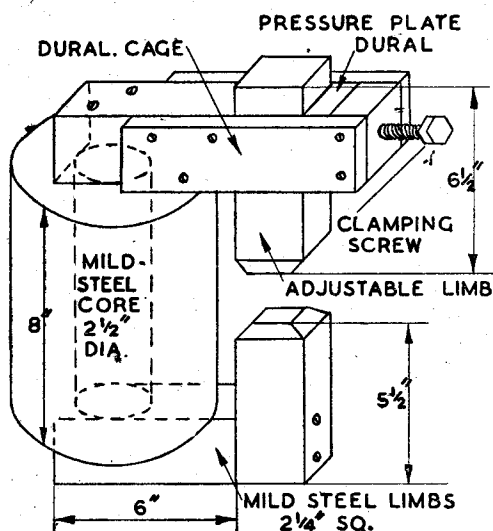
Construction

The limbs are attached to the core by two ½-in. B.S.F. bolts at each point, care being taken to ensure a good flat smooth surface to all contact faces. One limb is adjustable to accommodate various sized articles between the poles, and the design shown permits of this facility without reducing the area of the surfaces in contact, and is instantly adjustable.

The addition of some form of protective device for relieving the winding of the load induced by the collapse of the magnetic field was considered, but ruled out after having satisfied ourselves that other similar electro-magnets had been operating for many years without this, and were still surviving.

Operation

The operation of the magnetiser is quite straightforward. The article containing the permanent magnet which is to be magnetised is placed between the poles of the magnetiser so that the magnet is in line with the poles in the direction in which it is desired the magnetism shall be taken. The adjustable pole is lowered as far as

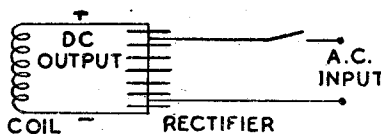


Sketch showing details of the D.C. electro-magnet

and has been found absolutely satisfactory in operation. The comparatively high inductance of the winding may reflect a somewhat slow collapse of the magnetic field, compared with a type using relatively few turns of wire but carrying an extremely high current; but, as stated, it fulfils adequately its purpose, and the total cost was only £13. If operating from d.c. mains, thereby eliminating the rectifier, the cost would be reduced to about £8, or still further if one has the means of winding the coil and of obtaining the quantity of copper wire required.

Data

Coil. 8,900 turns of 19 s.w.g. enamelled copper wire wound on a core 2½ in diameter × 8 in. long. Varnish impregnated. Overall finished diameter 7½ in. Weight 56 lb. Current consumed at 170 v. 2½ amps. £7



Wiring circuit

possible so as to reduce the gap to the minimum, and the clamping screw tightened. The current is switched on for two or three seconds, after which the poles are opened and the article removed.

In the case of magnet steels such as Alcomax and Ticonal, which have predetermined directional properties (termed preferred axis), provided such magnets are free to rotate within the poles of the magnetiser, the article may be inserted in any direction. On applying the current these magnets automatically rotate so as to assume their natural direction in the magnetic field.

Hornblocks for "Maid" and "Minx"

by "L.B.S.C."

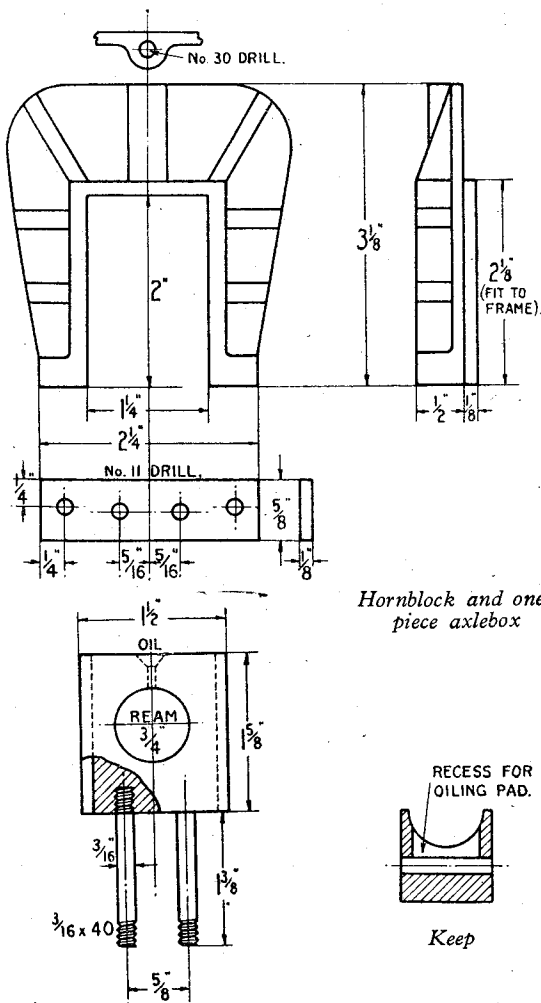
THE main hornblocks on both engines are identical, so both the "passenger and goods depts." can get busy right away. Castings will be available in good quality bronze or gun-metal; and if all our advertisers supply them as clean as a sample I already have here, very little machining will be required. This one merely needs a weeny bit of filing to make it fit the opening in the frame; and after riveting in place, a very slight smoothing out of the jaw sides, to bring them parallel (they are slightly wider at front than back, so that the pattern may easily leave the sand mould) is all that is needed. A piece of 1½-in. bar can be used as a gauge.

If the castings are much oversize, or rough, they will need a little more attention. I usually mill the contact faces of hornblocks on my vertical milling-machine. The casting is laid contact-face up on the table, over one of the tee-slots, and secured by a bolt between the jaws, with a square washer under the nut, the square washer being slightly less in width than the width of the slots in the engine-frame. An ordinary end-mill, or a home-made slot drill, is then placed in the chuck on the spindle; the work is lifted up to it by the vertical adjustment of the table, until the cutter takes a bite deep enough to remove the skin off the casting, and the latter is then traversed under the cutter. The cross movement of the table does the top part, and the longitudinal movement attends to the sides. For a gauge, I used a scrap bit of frame-steel with an opening cut in it, same size as those in the frames.

I don't imagine many home workshops include a vertical miller in their equipment; but if your lathe has a vertical slide, you can do the job just as easily. Incidentally, I might point out to the manufacturers of small lathes that a vertical slide should form part of the standard equipment of every machine, just the same as the

ordinary slide-rest. It is an invaluable aid to locomotive building, or indeed any small engineering work. The horn-block casting is bolted to the vertical slide exactly as described above, the end-mill or cutter being placed in the three-jaw, and the work fed into cut by means of the top slide or saddle movements. Then, by manipulating the cross-slide and vertical slide handles the casting can be traversed across, up and down, and the contact faces nicely machined off as easily as the vertical mill would do it. If you don't want to go to the trouble of making a gauge, set your ordinary slide-gauge so that the jaws are the same distance apart as the sides of the openings in the engine frame, and do your gauging with that.

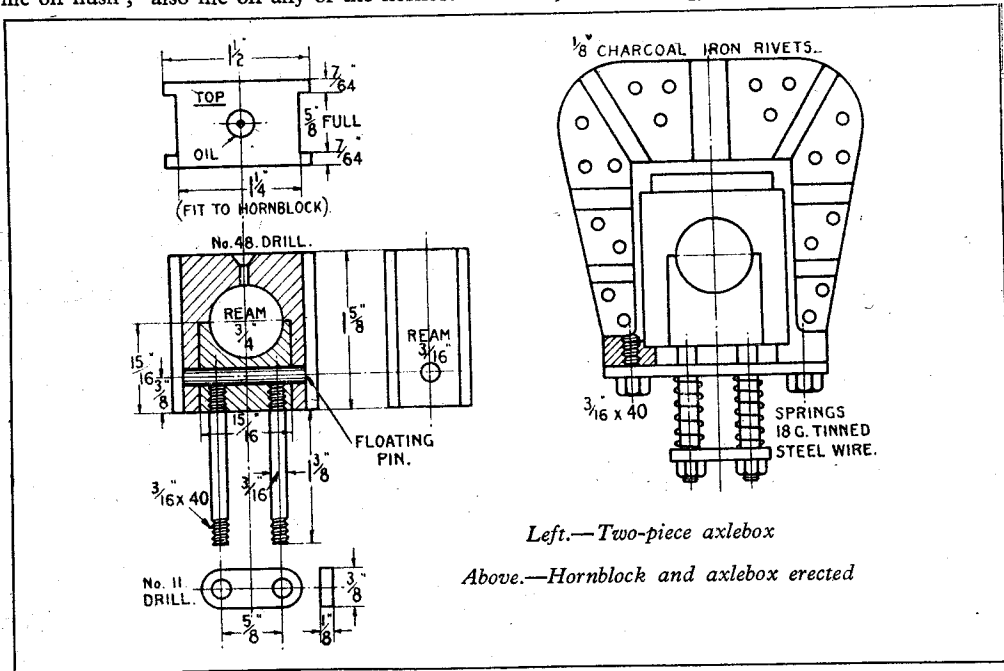
The top corners of the projection that fits the frame opening, must be rounded off with a file, to match the rounded corners of the opening; and a No. 30 hole drilled through the top rib, as shown. The hornblocks can be frame and riveted in as in the illustration I have shown you; but anybody who can use a lathe can use larger horn blocks. A lot of smaller



to receive the oil pipe. The hornblocks can then be fitted to the frame and riveted in position. In the assembly illustration I have shown twenty $\frac{3}{8}$ -in. rivets; but anybody who doesn't want to put in such a lot, can use larger rivets and not so many of them. A lot of smaller

ones, however, not only look like big practice, but are less liable to work loose. It is a good wheeze to centre-pop and drill the hornblocks before fitting to the frame, and if the burrs are cleaned off the contact-face, same will bed well down. Put a toolmaker's cramp on each hornblock as it is fitted, then drill for the rivets (No. 30 drill for $\frac{1}{8}$ -in. rivets) and countersink the holes on the outside of the frame. Hammer the rivets well down into the countersinks, and file off flush; also file off any of the hornblock

screws right into the centre of the hornblock feet. Temporarily clamp each one in position, then poke the No. 11 drill through the screw-holes, and make countersinks on the underside of the hornblock feet; follow up with $\frac{5}{32}$ -in. or No. 22 drill, and tap $\frac{3}{16}$ in. by 40. As screws of this size with 40-thread pitch are not made commercially, you'll have to make your own, but it is only a "kiddy's practice job." Chuck a bit of $\frac{1}{4}$ -in. hexagon steel in three-jaw, face the end, turn down $\frac{1}{16}$ in. length to $\frac{3}{16}$ in. diameter,



Left.—Two-piece axlebox

Above.—Hornblock and axlebox erected

jaw that projects beyond the surface of the frame plates. The two frames can then be bolted back to back—"inside out," as the kiddies would say—and each pair of hornblock jaws filed or milled out, until a piece of $1\frac{1}{4}$ -in. bar slides nicely between them easily but without shake. If you have a planer or shaper, the sides of the hornblock jaws can easily be machined, by clamping the frames in a machine-vice on the table, jaws upwards, and using a bent tool in the clapper-box, feeding downwards by the vertical adjustment provided. The bottom of the feet or lugs of the hornblocks should be filed or milled flush with the bottom edge of frame, whilst the plates are still bolted together. They can then be parted, and attached to buffer- and drag-beams as described in the previous instalments. The inner edges of the hornblock jaws can be smoothed-off with a file, to bring them to the right thickness, so that they stand out $\frac{1}{8}$ in. from the frames.

Hornstays

The hornstays are very simple, being merely $2\frac{1}{2}$ -in. lengths of $\frac{3}{8}$ -in. by $\frac{1}{4}$ -in. steel strip. The spring-pin holes are drilled on the centre-line, $\frac{3}{8}$ in. apart; but the holes for the fixing-screws are slightly offset as shown, in order to bring the

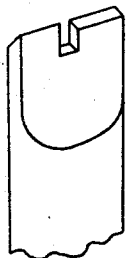
screw $\frac{3}{16}$ in. by 40 with die in tailstock holder (use plenty of cutting oil), part-off to leave a head $\frac{3}{8}$ in. thick, reverse in chuck, and chamfer the corners of the hexagon. You'll probably be able to make screws quicker than I can write the instructions!

Axleboxes—Solid Pattern

Two kinds of axleboxes are shown; "you pays your money and takes your choice." The first is the ordinary solid axlebox, as specified for $2\frac{1}{2}$ -in. and $3\frac{1}{2}$ -in. gauge engines; the second is a compromise between that and the full-size job, enabling the axleboxes to be removed from the axles without taking the wheels off, and also providing for a lubrication pad under the journal, same as on big sister. Either castings or rod material can be used; the former will probably be supplied with all the boxes in a stick. In the case of the latter, a piece of $1\frac{1}{2}$ -in. by $\frac{1}{4}$ -in. bar would be needed, long enough for four or six axleboxes, according to which engine you are building. By the good rights, this should be of hard phosphor-bronze. I made the driving axleboxes for "Grosvenor" from a piece of $1\frac{1}{2}$ -in. by 1-in. hard bronze rod, and boy—did it want some cutting! If you can get hold of

a bit, go ahead and make the boxes from it, as described below; but if you can't, use any other metal available, drill the axle hole 1 in. and fit a bronze bush. Even soft brass or "screw-rod" would do, as there is little, if any, wear between the horn-cheeks and the sides of the axleboxes.

Anybody who owns, or has the use of a milling-machine that will mill the grooves in the sides of a piece of bar, or cast stick, long enough for all the axleboxes, will be a lucky person, and also won't need any instructions on how to do the



Home-made
slot drill

job. If a small miller is available, the stick could be cut in half, and three (or two) boxes milled as one piece. If the job has to be done on the lathe, and the cross-slide will traverse $3\frac{1}{2}$ in. or so, you can do the boxes in pairs. Saw or part-off a piece of bar about $3\frac{1}{2}$ in. long, to allow sufficient for parting each pair of boxes and squaring the ends. Clamp it under the slide-rest tool-holder, at right-angles to the bed, and level with centres; then traverse it across a $\frac{3}{8}$ -in. end-mill or slot-drill held in three-jaw. In the days before I had a milling-machine, I did mine that way, and never bothered about setting the job square with a slide-gauge, rule, and scribing block. All I did was to put the face-plate on, run the slide-rest up to it, and hold the bit of metal so that it touched the face-plate full length, whilst I tightened the slide-rest clamp-screw. As the face-plate was dead square with the lathe bed, the bit of metal also couldn't be anything else!

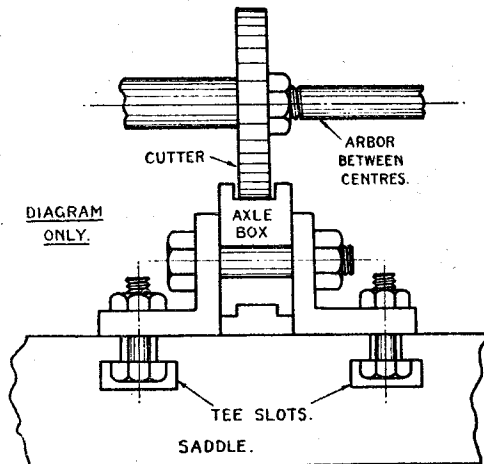
Another way would be to clamp the piece of bar in a machine-vice attached to the saddle. If you haven't a machine-vice, one can easily be improvised from two bits of stout angle-iron with a clamping bolt at each end to hold them together with the piece of bar between. This rig-up is held down to the saddle by four bolts in the tee-slots as shown, and in some cases it answers better than a regular machine-vice, as the whole space between the cutter and the surface of the saddle is available for the work. The groove is cut with a "regulation" side-and-face cutter on an arbor or spindle between centres. This need not be $\frac{3}{8}$ in. wide, as you can take as many cuts as you wish to get the desired width of groove; but the piece of bar must be set in the vice to a height sufficient to take out the full depth of groove at one go, as there is no means of gradual adjustment. After grooving the boxes, saw or part-off a shade over length, then square-off the ends to dead length with each box chucked in the four-jaw.

Fit each box to a hornblock, and mark it with a number; then take all the boxes from one side,

and mark-off for the axle-holes, $\frac{15}{16}$ in. from the bottom. Drill a pilot-hole in each with No. 12 drill. Now clamp each box to its opposite mate on the other frame so that they "match up" exactly, and put the drill through the other one, using the hole in the first as guide. Replace the boxes in the frame, and try a piece of $\frac{3}{16}$ -in. silver-steel (this will probably be the straightest stuff you have available) through each pair of boxes. If it lies dead square across the frames, O.K.; if it doesn't, correct the untrue hole with a rat-tail file, put a $\frac{1}{4}$ -in. drill through both boxes, and try again with a bit of $\frac{1}{4}$ -in. steel rod. When each pair of holes are exactly in the right place, clamp the boxes together again, open the holes to $47/64$ in. and poke a $\frac{3}{4}$ -in. parallel reamer through. Note: all drilling and reaming must be done either on a drilling-machine or in the lathe. Hand-drilling isn't the slightest use for axleboxes, as the holes must go through dead square for "sweet" running.

Axleboxes with Separate Keeps

In this type, the box is recessed out to both width and depth of $\frac{15}{16}$ in. and a block of that size fitted in, forms the "keep" or lower part of the axlebox. It is retained in position by a stout floating pin, the spring-pins being screwed into the bottom of the keep. The pin cannot come out when the box is in the hornblock, the latter holding it like a floating gudgeon-pin in an internal combustion cylinder. The axlebox castings will probably be made in pairs, with the openings at each end; and the side grooves can



Milling axlebox in improvised machine-vice

be machined exactly as described for the solid boxes, after which they can be parted, and the ends squared off. The recesses can either be milled, or planed, to get them true; they could also be carefully hand-filed. The keeps will probably be cast in a stick, or could be cut from a piece of 1-in. by $\frac{3}{4}$ -in. rod. Each keep should be a nice push-fit in the opening in the axlebox, and be flush with the sides. Clamp it in place with a toolmaker's cramp over the top of box and the keep; then mark a place $\frac{3}{8}$ in. from the

bottom of one of the grooves, and drill a No. 14 hole clean through box and keep. Ream it $\frac{3}{16}$ in., and fit a pin made from a piece of $\frac{3}{16}$ -in. round silver-steel. This should be able to be pushed in and out by finger pressure only. The boxes are then drilled for the axles, exactly as described for the solid boxes, the holes coming on the joint line between the keep and the recess, as shown in the sectional illustration.

holding the pin in three-jaw, and the die in the tailstock holder. Beginners often have trouble in getting the axleboxes to work freely up and down the hornblocks, because of pins jamming in the hornstays; so, for their especial benefit, I will repeat the easy-fitting process. Put each axlebox in its proper hornblock, and put the hornstays on. Jam a little wooden wedge between the top of the hornblock and the axlebox, so



On the right job at last!

Mount each keep on the slide-rest tool-holder, level with lathe centres, the semi-circular part facing the headstock, and put a $\frac{3}{8}$ -in. end-mill or slot-drill in the three-jaw. With this, mill out a recess at the bottom of the bearing, as shown in the detail illustration, cutting into the bottom of the hole for the cross-pin. When the axleboxes are finally assembled and erected, a wad of cotton waste soaked in oil, is placed in the recess, and keeps the bearing properly lubricated, so that the bugbear of "hot boxes" will never worry the driver. A No. 48 hole is drilled and countersunk in the top of each axlebox, and if two or three deep scratches are made between this and the oil-pad recess, the pad will never dry out. A similar oil-hole is needed in the solid box, and a couple of scratches made in the reamed hole, to distribute the oil from this, to the width of the bearing. You would be surprised how a scratch will distribute oil. In the old railway shops, the big-end brasses were fitted by filing, not scraping, and the scratches left in; the big-ends would run from one year's end to another, never get hot, and never knock, provided the driver did his bit with the oil feeder.

Spring-Pins and Plates

The spring-pins are $1\frac{1}{2}$ -in. lengths of $\frac{3}{16}$ -in. round steel, either mild or silver-steel will do. Put $\frac{1}{4}$ in. of $\frac{3}{16}$ in. by 40 thread on each end,

that the box is held tightly to the hornstay. Poke the No. 11 drill through the spring-pin holes in the hornstay, and make countersinks on the bottom of the axlebox; follow up with No. 22 or 5/32-in. drill, tap $\frac{3}{16}$ in. by 40, and screw in the pins. For the latter job I use a short bit of brass rod with a cross handle, the end of the rod being drilled and tapped about $\frac{3}{16}$ in. deep, to take the pin, allowing same to be screwed in tightly. If the pin is then gripped with a pair of pliers, the rod will unscrew off the end easily enough, leaving the pin in place.

Commercial $\frac{3}{16}$ in. by 40 nuts are not made, so you'll have to make your own; just chuck a bit of $\frac{3}{16}$ -in. hexagon steel in the three-jaw, face, centre, drill 5/32 in. or No. 22 for about 1 in. depth, and tap $\frac{3}{16}$ in. by 40. Chamfer the end of the hexagon, part-off a 5/32-in. slice, repeat operations until you get to the end of the hole, then drill and tap again. Burring caused by the parting-tool can be removed by filing, or by facing in the lathe; for the latter, chuck a bit of steel rod about $\frac{1}{4}$ in. or $\frac{5}{16}$ in. diameter, turn a $\frac{3}{16}$ -in. pip on the end about $\frac{1}{2}$ in. long, screw it $\frac{3}{16}$ by 40, and screw each nut on the pip. The nut will run perfectly true, and can be faced off quicker than I can write these words. Use a little spanner to release the nut, as pliers will spoil the corners of the hexagon.

(Continued on page 43)

MILESTONES and RAILROADS

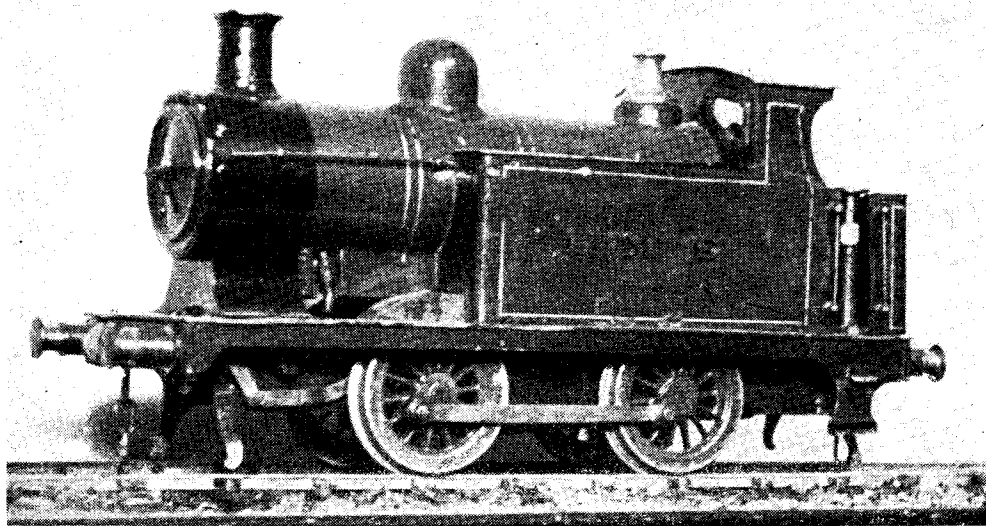
by G. R. Hill, A.M.I.Mech.E., A.M.I.P.E.

IN January 1898, THE MODEL ENGINEER AND AMATEUR ELECTRICIAN made its debut. In January this year, it celebrates, after changes of name and style, fifty years of unrivalled progress in the field of miniature and contemporary engineering. Many of those early enthusiasts who did so much in contributing to the enthusiastic development of our absorbing hobby have gone from amongst us, to mention only Mr. Alfred W. Marshall, Mr. H. Muncaster and Mr. Henry Greenly, but in the words of the famous advertisement THE MODEL ENGINEER is "still going strong" or is this quite correct? Let us alter it to "going stronger than ever."

Some twenty years ago I caught the fever, and

its single oscillating cylinder and smelly burner functioned in no uncertain manner, but it was singularly lacking in power, and except as a model locomotive was neither "a thing of beauty" nor "a joy forever." It was to be preserved however as the first milestone to greater efforts to emulate the fine engineering achievements of Sir Henry Fowler, Sir Nigel Gresley and Sir William Stanier.

A 2½-in. gauge "Royal Scot" followed the four-wheeler and was run to death. It had the honour of being driven on the track by the mayor at the opening ceremony of the first exhibition held by Southampton Model Engineering Society, and ran throughout the week of



The author's first attempt—a ½-in. scale 0-4-0 tank locomotive

have never yet thrown it off, nor can I say I wish to; and what more fascinating branch than railroads?

The photographs show a few examples of railroad milestones which, although they may be termed a busman's holiday, have followed and no doubt will continue to follow with the utmost regularity, as time and skill permit.

The first picture shows a little ½-in. scale 0-4-0 tank engine built by the writer as a first attempt in 1925, after the acquisition of a 3-in. lathe and sundry tools, and was constructed to a design by Mr. Henry Greenly published in THE MODEL ENGINEER on March 1st, 1902, which issue, along with many others, came into the writer's hands in one of those mysterious ways which have no explanation. At the trials

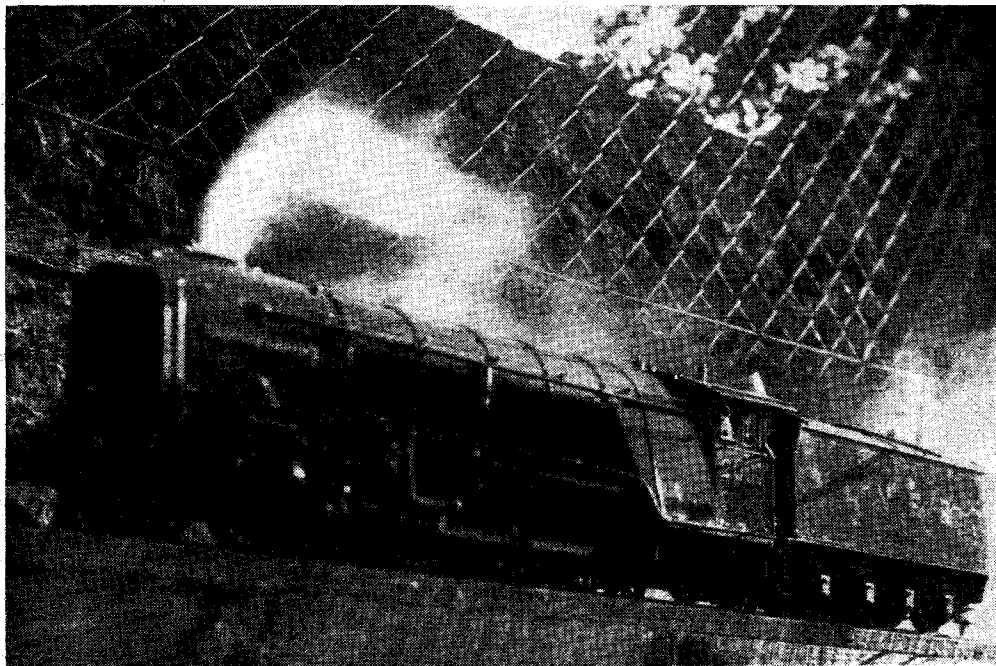
of the exhibition giving pleasure and excitement to several hundred children.

About this time I built my first railway—some 60 ft. of track on wooden posts.

The second picture shows the 2½-in. gauge L.N.E.R. Class P2 engine, "Sir James Jeans," commenced in 1934 and which won a challenge cup in 1938. This engine was built without drawings, other than an outline sketch of the prototype "Cock o' the North," but much of its success must be attributed to the words and music of that famous MODEL ENGINEER contributor "L.B.S.C.," who has done so much to awaken and sustain the enthusiasm of the vast present-day army of locomotive fans. "Sir James" is, as nearly as possible, a faithful reproduction of the prototype, having three

cylinders, double blast pipe arrangement, Cartazzi trailing truck axle boxes, etc., and is fitted with drop-gate and a mechanical lubricator. The whistle of the prototype is placed in front of the chimney, in the model this whistle acts as the anti-vacuum or snifter valve, being ideally situated for this purpose. This engine has run consis-

whose? Much domestic arbitration took place, criticism was sought, and eventually the nameplates were made and fitted bearing a name we model men know and respect so highly, and has steered the THE MODEL ENGINEER throughout its history of half-a-century—"Percival Marshall."



A 2½-in. gauge L.N.E.R. class P2 locomotive, "Sir James Jeans," winner of a challenge cup in 1938

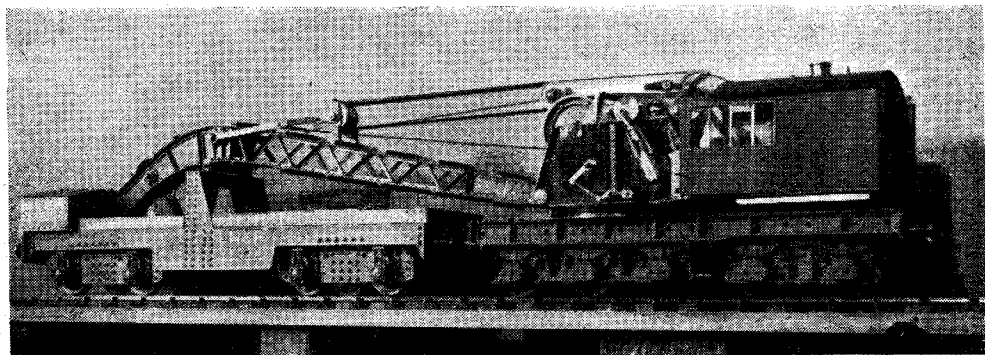
tently right up to date, the only major repair being the fitting of a new firegrate as a replacement for the original grate burnt away in the days when coal was coal. THE MODEL ENGINEER, of November 20th, 1947, has a very fine photograph, as cover picture, of the original "Cock o' the North" crossing the Forth Bridge. The little engine can lay claim to a similar landmark in model railway history, it has also crossed the Forth Bridge.

The next milestone, if one may call it such, was a departure from 2½-in. gauge to 3½ in. and the "keel" was laid for a ¾-in. scale L.M.S. Pacific. This engine was built mainly during the late war and the construction was maintained faithfully to prototype in spite of all the late and unlamented Adolf could do to prevent it. This engine has four cylinders with all the adjuncts of a modern model, such as injector, mechanical lubricator, Ross pop safety-valves, Walchaerts valve-gear, etc. The construction of it required seven years, although at the time it shared the erecting shop with a still more ambitious contribution. The naming of this engine took, I think, more thought than the whole of its construction. Was its general construction and workmanship worthy of a great name, if so,

It has been described and illustrated in a past issue and travelled a thousand miles to and from the 1946 Model Engineering Exhibition where it secured a V.H.C. Diploma. Without doubt a very encouraging and outstanding milestone!

Now to the latest and greatest. The third picture shows a ¾-in. scale model of a modern, 40-ton railway breakdown crane, which shared erection with "Percival Marshall." It constituted a change, not that familiarity bred contempt, from locomotives, yet kept the railway interest and flavour. Though not yet quite complete, and as yet having the superstructure unpainted, it is being pushed forward with maximum effort to visit the Model Engineer Exhibition in 1948. There are nearly 2,000 1/16-in. rivets in it and countless 1/16-in. bolts and nuts. Official drawings were used for the truck and jib, but in one of his night attacks on a defenceless city, the aforementioned enemy No. 1 succeeded in destroying the drawing offices of the builders of the prototype, and with them the drawings, so that the superstructure with engines, gearing and boiler have been constructed from a few home-done sketches.

The crane has slow and fast hoisting motions



The latest and greatest.—A $\frac{3}{4}$ -in. scale model of a modern 40-ton railway breakdown crane

and travelling, slewing and luffing motions actuated by spur, bevel and worm gearing with sliding pinions and clutches, the whole of the gears having been actually cut in the workshop. The boiler is of the Hopwood type and is $3\frac{1}{2}$ -in. diameter and $6\frac{1}{2}$ -in. high. The engines are $9/16$ -in. bore by $\frac{3}{4}$ -in. stroke with Stephenson link reversing motion.

In the midst of this galaxy I visualise our Editor reaching for his blue pencil, but I cannot conclude without confessing to one transgression from railroads, namely the building of a little compound vertical engine having cylinders $\frac{3}{4}$ -in. and $1\frac{1}{4}$ -in. by 1-in. stroke. The Royal Scot model mentioned above was intended to have a displacement lubricator, which however

looked unsightly when fitted, and was removed. The compound engine was accordingly built to use up the lubricator.

The wonderful record of our honoured friend and contributor "L.B.S.C." must receive mention. Without doubt he has done more than anyone to promote the present-day interest of countless loco. fans with his "live steamers," of which I have built "Molly" and find this to be a pretty little job, well designed and full of pep. . . . May I recall our late and mutual friend Brother Wholesale's amusing description of "L.B.S.C.'s" introduction to the Bursledon nettle-bed, and express the hope we will find his "live steam" notes in *THE MODEL ENGINEER* till the latter's diamond jubilee and after.

"L.B.S.C."

(Continued from page 40)

Spring Plates

These are $1\frac{1}{8}$ -in. lengths of $\frac{1}{8}$ -in. by $\frac{3}{4}$ -in. steel rod, with two No. 11 holes drilled at $\frac{3}{8}$ in. centres. The ends are rounded off as shown. The springs are wound up from 18-gauge tinned steel wire, over a bit of $\frac{1}{8}$ -in. round rod held in the three-jaw. Bend one end of the wire at right-angles, to go between the chuck jaws; then pull the belt by hand, and guide the wire on to the rod evenly for about three or four turns. If you then press your thumb hard on the coils thus made, the rest of the wire will automatically space itself into even coils. Cut the springs to length, and touch the ends on the side of your emery-wheel, with same running at full speed; this will make the ends lie flat. The length of the finished spring should be approximately $\frac{7}{8}$ in. Assemble as shown in the illustration; then put a little block of metal (short bit of $\frac{1}{8}$ -in. square rod will do fine) between the bottom of the axlebox and the hornstay, and tighten the nuts so that it is firmly held. This will hold the axlebox in the running position whilst

the cylinders and motion are being erected.

The "Claughton's" Good Deed

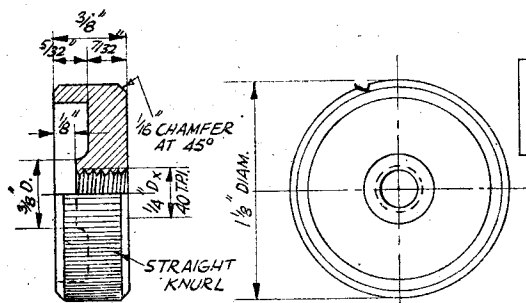
Several times in these notes, I have mentioned "the Colonel" and his "Claughton," but have never been able to show a picture of her. Well, to make amends, on page 40 are both of them! The occasion was at a "gathering of the clans" at Hutton House, near Penrith, in aid of the County Nursing Association, when the engine ran all one afternoon hauling fare-paying passengers, and earned quite a respectable amount for a worthy cause. The locomotive is a complete refutation of the ancient idea that a $3\frac{1}{2}$ -in. gauge engine of her type could not be a success, as the firebox was too shallow. The boiler steams the four cylinders, and has a bit to spare; the shallow firebox never gives the slightest trouble, and the engine upholds the honour of what was "England's premier railway" in a manner that delights the heart of my old friend, who should have been a L. & N.W.R. driver instead of an Army officer!

*A Simple Cycle Lighting Dynamo

by Edgar T. Westbury

THE friction wheel is turned from mild-steel, and must be concentrically true all over. The edge must be coarse knurled or serrated to improve the driving grip, but a sharp-edged knurl, particularly a diamond knurl, is liable to cut the tyre, and the best method is to serrate the edge with a narrow round-nosed tool laid on its side in the tool post, and racked backwards and forwards.

an angle of 120 degrees, so that in conjunction with the magnet pole faces of 90 degrees, they produce an overlap of 15 degrees on each side when in the neutral position. Readers who have followed the articles on magneto design will remember that I recommended keeping the overlap of the poles very small, but in that case the object was to steepen the rise and fall of



DRIVING WHEEL - 10FF - M. STEEL

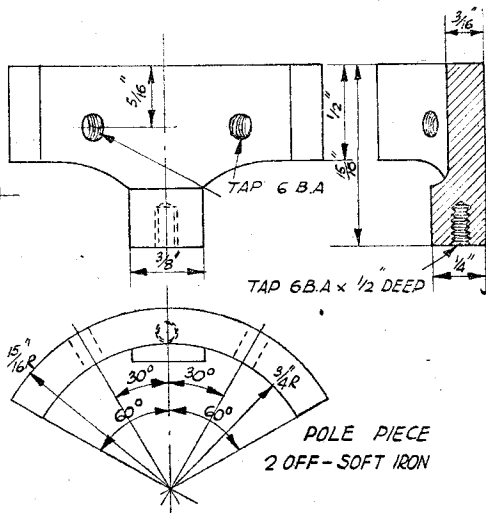
Index the work between cuts by one of the many devices for this purpose which have been described in THE MODEL ENGINEER, about 60 divisions being suitable. All this can be done before parting off.

It will be seen that the friction wheel, when screwed home on the shaft, forces the centre ring of the ball-race hard against the end of the distance bush, which clamps the second race against the shoulder on the shaft. The recess of the friction wheel, and the inside of the lip, should be just—but only just—clear of the end face and rim of the housing, thus forming a dirt excluder and retaining lubricant in the housing, an auxiliary seal in the form of a felt washer also being provided. When the rotor shaft assembly is fitted, it should spin quite freely, and the pole faces of the magnet should run perfectly truly.

Pole-pieces

In the absence of special Swedish iron or other material of guaranteed magnetic properties, it will be found that good quality mild-steel or "deep drawing" steel will serve fairly well if thoroughly annealed before use. The pole-pieces may be bent to shape and secured in place for final machining of the internal surfaces; but it will probably be easier, more accurate and just as quick to machine them from thick-walled tube or solid bar material, cutting them to shape afterwards, so that they need only be secured in place in the casing, and need no subsequent machining.

It will be seen that the pole faces extend over



current, and produce a peaked wave form. The object now, however, is entirely different, as the machine is a "current generator," and it is desired to produce a sinusoidal wave form, in which the *mean* height, not the *maximum* height, of the peak is the more important.

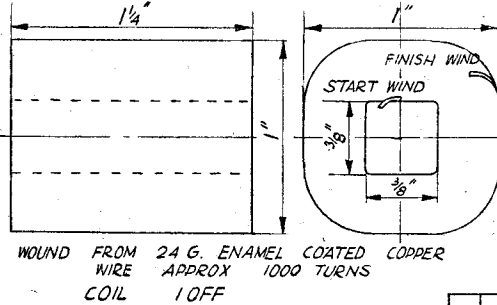
The pole-pieces should be made to fit neatly to the inside of the casing, by whatever method they are produced, and the internal surface should just clear the magnet by an amount sufficient to ensure free running, and no more. Remember that the air gap between rotor and stator in a dynamo is an inevitable source of inefficiency, and the finer it is kept, short of scraping, the better will be the result. It is possible, with really accurate machining, to work to a radial clearance of 0.002 in., but 0.005 in. is more common and should be quite easily maintained.

Coil and Yoke

The coil should present no difficulty, even to the mere novice, and the method of winding is a matter of individual preference. Some constructors may prefer to use a bobbin, and pile-wind the wire on it, slipping the core in afterwards, while others may prefer to wind direct on the core, with or without interleaving.

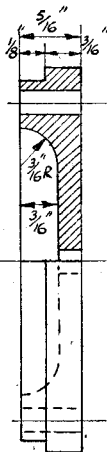
*Continued from page 695, "M.E.," Vol. 97, December 25th, 1947.

Insulation problems are not very serious, as the voltage handled is low, but reasonable precautions should be taken against breakdown, such as by chafing of the wire covering, if enamelled wire is used. The dimensions given for the coil represent the maximum which can comfortably be accommodated in the available space, but it should be quite easy to get in the specified number of turns.

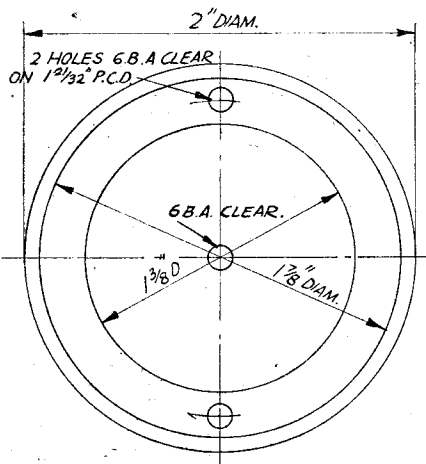


Should a bobbin be used, it should be of fibre or similar material, not metal, as this would introduce a "shade ring" effect and damp out the current surges. If the wire is pile-wound on the core, the upper layers will have to be made progressively shorter, to prevent the slipping of end turns. Taking things all round, I prefer to interleave the turns with paper, as this simplifies even winding and supports the layers effectively, while final impregnating or even just dipping in varnish solidifies the whole assembly and gives both electrical and mechanical protection. In any case, the core should be insulated by two or three turns of stout paper before winding. It may be supported in the lathe by cementing end caps on temporarily, to run between centres.

The core, or "yoke," of the coil is shown in the drawing as best made in the form of a pack of soft iron laminations, 24 gauge being a suitable thickness, though good results have been obtained with other thicknesses, both above and below this gauge. These should be either cemented or riveted together, and should be disposed edgewise on to the pole-pieces. It will be seen that slots are formed in the ends of the core to take the holding-down screws; this may be done by making the centre lamina-



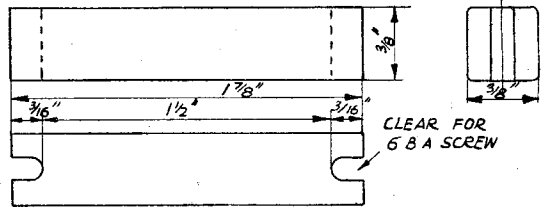
CAP - 1 OFF - MATERIAL EBONITE



CORE - 1 OFF - LAMINATIONS OF 24G. SOFT IRON

tions shorter than those on the outside. Take the hard corners off the core, at least over the wound portion, and face the edge which rests on the pole-pieces, to provide the closest possible contact all over; then put on one or two layers of tough paper to form a foundation for the windings.

Should it be found difficult to obtain the gauge of wire specified, it is permissible to use either larger or smaller gauge wire, putting on as many turns as can be accommodated in the space allocated, in either case. This will alter the voltage and current output of the machine, which must be allowed for in the choice of lamp used; but small permanent-magnet dynamos have quite a wide range of self-accommodation in this respect, as the voltage rises when the resistance of the circuit is increased, and drops when it is reduced. In any case, it will probably be found desirable to make some experiments with lamps of different voltage and current rating, and in the event of a tail-lamp being used



in addition to the headlamp, series or parallel connection of the two lamps may be tried.

Methods of Connecting Up

Series connection is the more common in cycle dynamos, and calls for lamps of lower voltage than the full output voltage of the machine. The lamp having the lower current rating of the two will burn the brighter, and should be used for the headlamp; with parallel connection, the reverse will apply. Each lamp should be rated for the full supply voltage, and the one with higher current rating will burn brighter.

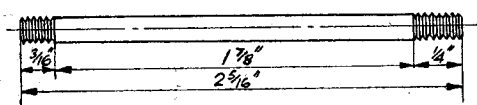
For series connection, the live wire is taken from the dynamo to one terminal of the headlamp, and the other headlamp terminal connected to one terminal of the tail-lamp; from which the circuit is completed either by earth return or another wire back to the dynamo. For parallel connection, two wires are taken from the dynamo

live terminal, one to each lamp, and the circuit is completed either by earth return or by a wire from each lamp back to the dynamo.

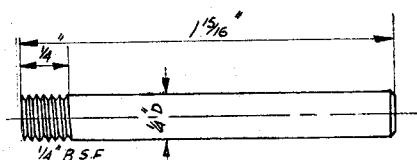
Cover Plate and Terminal

The cover plate is specified as being made of ebonite, though other insulating materials may be used so long as they are impervious to water and not likely to swell or warp under variable

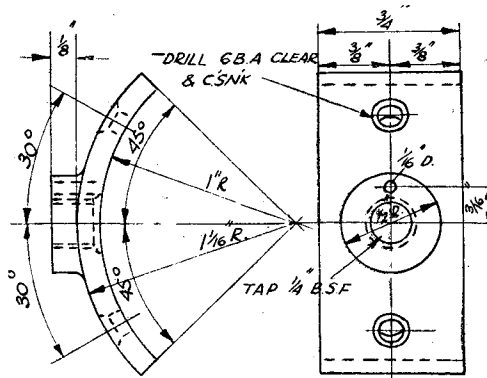
This completes the connections for the dynamo, using an "earth return" circuit, which is perfectly satisfactory, provided that due care is taken to make certain that the carcase of the dynamo, and both the lamps, make a good metallic connection with the frame of the bicycle. If, however, a fully-wired circuit is preferred, two live terminals may be provided in the cover plate, connected to the inner and outer ends



SECURING BOLT - 2 OFF - BRASS



SWIVEL PIN - 1 OFF - MILD. STEEL



SADDLE PIECE - 1 OFF - AL ALLOY

climatic conditions. Alternatively, a metal cover may be fitted, having an insulating bush to take the live terminal. Any convenient form of terminal may be used, so long as it provides a sound and permanent connection; with screw terminals, the use of a spring washer or other form of locking device is advisable.

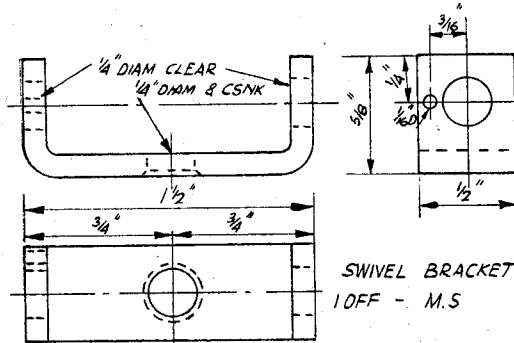
Internally, the connection from the coil to the terminal may be made in any convenient way. Sometimes a spring brush is attached to the terminal so that it bears on a tab or stud on the windings, but for a low-voltage machine, a positive lead from the outer end of the coil

of the coil winding respectively, and insulated from each other and the frame. There is no positive or negative on an a.c. dynamo, so it does not matter which dynamo terminal is connected to which lamp terminal.

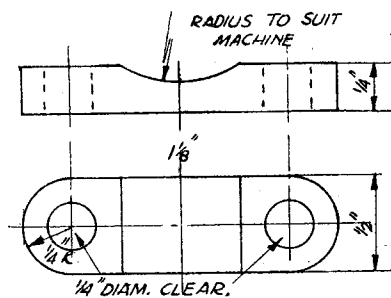
The cover plate is held in place by nuts fitted to the two long brass studs which pass through the casing between the pole-pieces, and are tapped into the flange of the housing.

Saddle-piece

This should be made of brass, gunmetal, or



SWIVEL BRACKET
1 OFF - M.S.



FRAME CLAMP - 2 OFF - M S

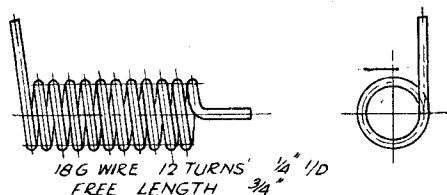
winding is more reliable. The lead should be flexible, and long enough to allow of removing the cover without risk of breaking it; this may be arranged by coiling the lead-out wire in a tight spiral where it comes out of the coil. At the inner end of the winding, the wire should be similarly coiled, and carefully earthed to the core by soldering to a tab washer clamped under the head of the core holding-down screw.

aluminium alloy, shaped to fit closely to the outside of the casing, and having the boss tapped to fit tightly on the screwed end of the swivel pin. A small casting would be most convenient for this part, but it may be cut from the solid if this is not available. It may be found desirable to slightly countersink the inside of the tapped hole and make the screwed end of the pin long enough to rivet over, but it should be finished

flush with the inside surface afterwards. The saddle-piece may be secured to the casing by the two screws which hold one of the pole-pieces, but it is desirable to fit an extra screw in the latter, under the saddle-piece, so that it does not shift if the other two screws are removed.

Swivel Bearing Bracket

This may either be bent to shape, cut from



TORSION SPRING - 1 OFF - SP STEEL

solid, or cast, as most convenient; in the latter case, tough gunmetal is recommended. It is securely attached to the stud by screwing and riveting, and in this case, as with the saddle-piece, the threads of the stud should be on the tight side to avoid risk of working loose. Drill the holes in the lugs of the bearing bracket at right-angles to the stud, and reamer them to a running fit on the swivel pin.

Frame Clamps

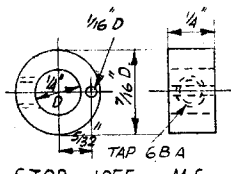
In this case also, there is a latitude in the choice of material, but it must be something strong enough to resist bending under the pull of the clamping bolts. The inner surface of the clamps should be shaped to fit closely to the bicycle-frame members, which are usually of oval section at the place where the dynamo is to be attached.

It will be seen that a short $\frac{1}{8}$ -in. pin is fitted in the face of the boss on the saddle-piece, to engage a hole drilled in the adjacent face of the swivel bracket, and hold the dynamo away from the wheel when not in use. To locate this pin, it is best to fit the dynamo temporarily on the bicycle, setting it so that its axis is truly radial to the cycle wheel and its friction wheel comes in contact with the side of the tyre. Then locate the pin so that it holds the dynamo with the friction wheel about $\frac{1}{4}$ in. from the tyre.

Torsion Spring and Spring Collar

This may be wound from 18-gauge piano wire, but it is a fairly common type of spring, which may be obtainable ready made. One end of the spring is bent at right-angles, and anchored in a steel collar which is attached to the swivel pin by a sunk grub screw; the other end of the spring projects at a tangent, and bears on the flat surface of the swivel bracket. After fitting, this end may be bent back over the edge of the bracket to provide extra security. The spring may be tensioned by turning the collar to any desired position, after which an indent is formed in the pin to take the end of the grub screw and prevent it shifting.

The catch pin in the saddle-piece may be made of $\frac{1}{8}$ -in silver steel, screwed $\frac{1}{8}$ -in. Whit. or 5-B.A. to fit an appropriately tapped hole in the flange, and should project quite squarely for a length of about $\frac{1}{4}$ in. It holds the dynamo out of contact with the wheel when engaged, but by pulling the dynamo endwise to release the pin, the spring is enabled to apply the necessary torsional pressure to keep the friction wheel in



STOP - OFF - M S

contact with the tyre and compensate for normal errors in the truth of the bicycle wheel.

Magnetising the Magnet

As already explained, it is desirable to leave the magnetising until the dynamo is fully assembled, and in the event of suitable equipment for magnetising not being readily available, it is advisable to solicit the assistance of a magneto repair firm for this operation, which should not entail very great expense. The saddle-piece should be removed from the dynamo, and the rotor shaft turned to put the magnet centrally in line with the pole-pieces (the end cover may be removed to facilitate inspection, but do not remove the coil). Indicate the positions of the pole-pieces plainly, so that they can be correctly located between the poles of the magnetising magnet.

It is most important that the magnet should be properly saturated, or the full efficiency of the dynamo cannot be obtained. After magnetising, it should never be removed from its closed magnetic circuit if this can possibly be avoided. Under normal conditions, some slight loss may be expected during the "ageing" period of the magnet, but after that, its efficiency should be practically constant over a very long period, so long as the magnet is not removed or the dynamo damaged by dropping or similar maltreatment.

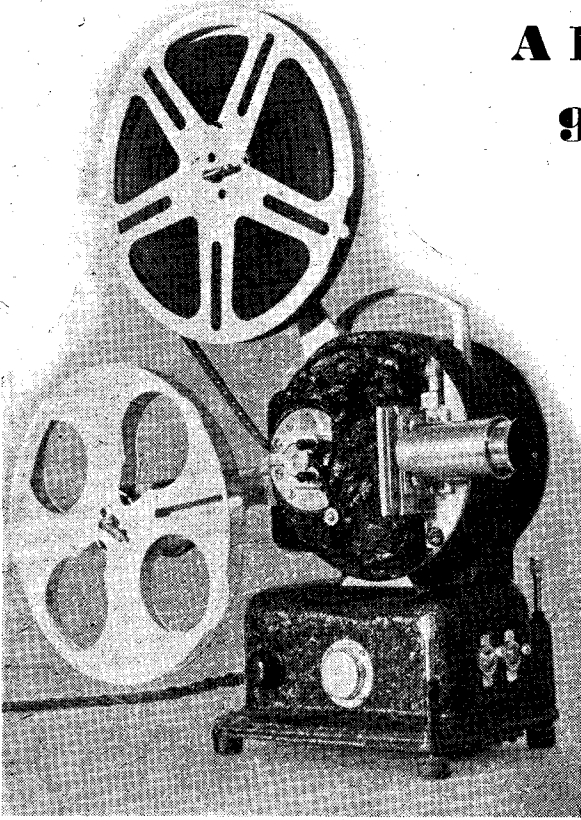
The principles used in the construction of this dynamo may be adapted to any low-power a.c. generator, and an almost identical machine may be used in conjunction with working models which require lighting current, such as the searchlight of a model destroyer or a breakdown crane. Used in conjunction with a suitably calibrated voltmeter of the moving-iron type, or a moving coil meter having a rectifier in circuit, it forms a practical remote-recording tachometer or speed indicator. It is even possible to produce direct current for charging small batteries, by connecting a suitable metal rectifier in the output circuit, though it is not so efficient for this purpose as a rotating-armature machine fitted with a commutator.

A 100-Watt

9.5 m.m.

Cine-Projector

by G. Oulianoff



The rubber feet were purchased at a sixpenny store and mounted on ball jointed screw adjusters for tilting the projector.

The main circular gear case was machined from part of a pneumatic cylinder casting found in a scrap box.

The main driving shaft passes through this with a heavy brass flywheel and driving pulley combined at the lamp-house end, and the double cam motion which operates in the hardened claw shuttle at the gate end. This shaft runs in lapped phosphor-bronze bearings with a cast outrigger bracket supporting the bearing at the flywheel.

On this shaft and inside the gearcase is mounted the three-bladed shutter and

a small pinion. This pinion engages with a spur wheel which gives a 7 : 1 reduction to the sprocket for film feed and take up. These gears came out of a very old phonograph. Mounted concentrically on the sprocket shaft is the pulley for the take up belt to the lower reel arm. The whole projector mechanism thus consists of only three moving parts, not including the motor and belts.

Condenser Mounting

The double plano-convex condenser is mounted in the gearcase between the lamp and shutter and is accessible from the lamp-house, and on the outside of the casing is the tube housing the surface-silvered mirror. This, with the cam and shuttle mechanism, is in turn enclosed in the brass casing which can be seen in the photographs.

The double cams impart a rectangular motion to the twin claws, which enter the film perforations, engage the bottoms of the slots and give an extremely rapid transit to the film without shock or noise, thus enabling the shutter to have very narrow blades of equal width, this resulting in high optical efficiency.

The gate and lens tube were both built up from scrap bits of very hard aluminium, and so far the wear on the gate has been negligible, and

THIS is a description of a projector which was designed and partly built by Mr. George Shimmin, of Duffield, Derby, and completed by myself.

Starting at the base, the bottom casting is of aluminium, and this once served as some form of cover on an electrical appliance in an American bus. This houses the motor, the centrifugal fan, fan casing, motor control resistance, wiring and the lamp and motor switches.

The motor is a 24-volt a.c./d.c. machine, which I believe saw service during the war in a Sherman tank. On the spindle is mounted a turned-down vacuum cleaner impeller incased in a brass volute, which directs a high-velocity blast of air into the lamp-house. The duct carrying this air may be just seen at the front of the projector. On the extreme end of the shaft is the pulley for the rubber belt drive to the flywheel.

The knob at the rear of the casing is the resistance speed control for the motor. This once graced the dashboard of a very expensive motor car.

The two switches which can be seen on the front are for the motor and lamp respectively.

The aluminium cap on the side of the base covers a hole cut in the casing, which was necessary to clear the motor bearing housing.

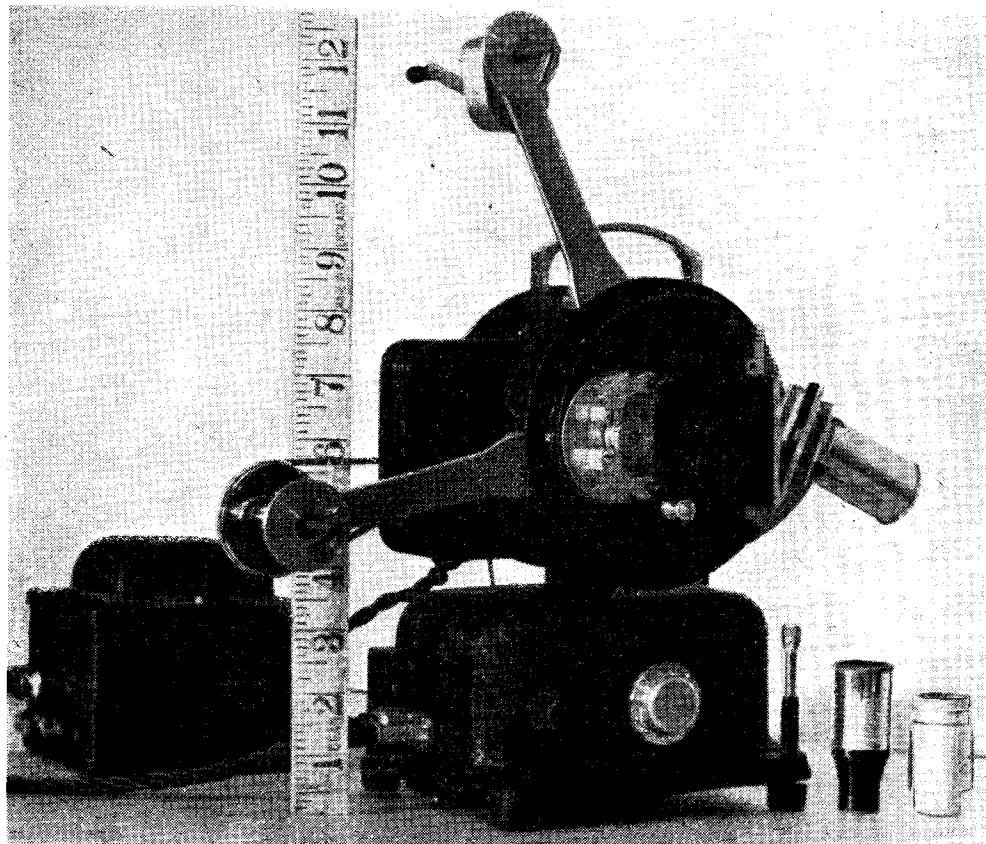
the rubbing surfaces have attained a very high degree of polish.

On lifting the small catch, seen above the lens tube, the whole lens and gate assembly swings forward on a ball catch for easy film threading; further movement swings the gate out at 90 deg. for cleaning.

The lens now in use is a Dallmeyer *f.1.8* of 1-in. focus. The original Pathé Home Movie

to two flat mica strips. The mica and the flat resistance wire were taken from an electric-iron element specially purchased for this purpose. Tappings from this lead to a voltage selector knob on the side of the resistance case, giving a range of voltages from 210 to 250 volts.

The Tee section reel arms are made from aluminium shelf brackets, also obtained from the sixpenny stores.



The film gate is shown open at the intermediate position for threading

lens, which had a much smaller aperture, may be seen on the photograph, standing beside the Dallmeyer, in its special mount.

The circular lamp-house was made from an old Kodak developing tank. This has a bayonet fitting lid, which now gives quick inspection of the lamp, condenser and reflector.

The last item is fully adjustable, together with the lamp.

The lamp is so positioned that all the cooling air from the fan passes in a high velocity blast over the lamp, condenser and reflector, and thence up and round the lamp-house, where it comes out through an aperture at the bottom and out through the resistance case.

This latter is attached behind the lamp-house and may be seen in the photograph. Inside the case is the lamp resistance, which is wound on

The hand re-wind (which I prefer) is made from two Meccano gears suitably modified, the whole being housed in a case machined from a solid piece of aluminium sawn out of a section of a scrap aero piston. The carrying handle is also a section taken from the same piston.

The transformer which feeds the motor originally gave an output of either 6 or 12 volts. It was found that when working on 210 volts mains the 12-volt output did not provide sufficient power from the 24-volt motor, so a few extra turns of wire were wound on to the secondary, giving approximately 15 volts, and this has been found adequate for all conditions.

When running at 16 frames per second the motor holds the speed well, and it is seldom necessary to adjust the speed control during showing. This steadiness is no doubt due to

the very light and balanced motion and heavy flywheel.

The projection is excellent, the picture is rock-steady and absolutely flickerless, and a picture 5 ft. wide can be easily obtained with films which are not over dense, although I usually show a width of about 36 in., due to the small size of room available at home. At this size the picture is brilliant.

I did consider fitting a 200-watt lamp, but on further thought decided that it was hardly worth while.

Everyone who has seen the projector has remarked on the silence of the machine, as, apart from the hum of the motor, there is practically no mechanical noise. I have finished it in crackle enamel with the aluminium parts polished bright, and found it rather difficult to photograph.

I have estimated that to date the projector has done about 50 hours' running; this includes test and experimental time. The original lamp is still in service and shows no signs of burning out, in spite of the fact that it has been over-run on one or two occasions during experiments with the resistance. This, I think, is a good testimony for the adequate cooling of the centrifugal fan.

Finally, I think that this machine is a great credit to Mr. Shimmin, who did all the fundamental design and construction, and although the whole thing was in a "lash-up" state when I took it over, it screened the pictures with the same precision as it does now.

The overall size of the machine, excluding the reel arms and lens tube, is only $9\frac{1}{2}$ in. high \times 6 in. long \times 5 in. wide!

Editor's Correspondence

Calorific Value of Fuels

DEAR SIR,—To my mind, Mr. R. E. Mitchell's reasoning (Petrol Engines and B.H.P. Measurement, October 23rd issue), with regard to Mr. Cruickshank's measurements is a little confused.

Surely the power produced by different, otherwise suitable, fuels in the same engine is, for all practical purposes, proportional to their calorific values. Further, for the same fuel the power produced is proportional to the compression ratio—the limit being determined by detonation. It is, I quite agree, correct to say that for a given volume of air an "ideal" alcohol/benzene/air mixture has a higher calorific value than the ideal petrol mixture. However, I do not consider that the fact need concern us in this case, since an engine must always take, under identical running conditions, the same volume of any fuels of approximately the same specific gravity from its carburettor unless and until the setting of that instrument is altered by the operator.

It follows that to burn an alcohol mixture in an engine tuned to burn petrol is a waste of time and effort, unless, for some reason, very cool running is required.

In my opinion, Mr. Cruickshank's figures demonstrate this, and it is Mr. Mitchell's that are difficult to understand—difficult, that is, unless it is assumed that his engine was tuned between tests for maximum results from each particular fuel.

Yours faithfully,
PETER TWISS.

Partridge Green, Sussex.

DEAR SIR,—I thank you for forwarding a copy of the letter you have received from Peter Twiss, and am pleased to offer the following reply.

The calorific value of a fuel is usually given on a unit weight of the material, but the power output of an I.C. engine is limited by the charge of combustible mixture drawn into the cylinder.

Since this is mainly air, the best performance will be given by a fuel that gives out the most heat when burning with this quantity of air, and alcohol holds an advantage over petrol in this respect.

I agree that more weight of fuel is needed and the jet must be enlarged to cater for the new conditions. The carburettor fitted to my engine is of an extremely simple type and very popular, consisting merely of a Venturi with needle-valve jet and a strangler on the atmosphere side. This gives no compensation and the needle-valve controlling the fuel has to be adjusted in combination with the strangler. Since I am interested in all-out running at almost constant speed, the more complicated types are not necessary. As far as can be seen with the photograph in Mr. Cruickshank's article, he also used a similar carburettor.

While making my h.p. determinations the fuel jet was adjusted to allow for the changed conditions, and I regret that no mention of this was made. However, Mr. Cruickshank stated in his article, "Jet and ignition settings were adjusted in each case while running to obtain optimum results."

Yours faithfully,
R. E. MITCHELL.

Runcorn.

The Heat Pump

DEAR SIR,—In your issue of September 28th, Mr. Brocklebank has, I think with his tongue in his cheek, raised the question of the heat pump, and states, although without substantiation, that he thinks the theory is fallacious.

The so called "Heat Pump" is a machine working on a refrigeration cycle, which with the expenditure of mechanical energy, transfers heat from a cold body to a hotter one. The most common example of the heat pump is the ordinary domestic refrigerator, and if we consider the cycle in stages it is apparent that there is no fallacy in the system.

Firstly, consider a refrigerant in the form of a gas that is compressed with the aid of mechanical energy to such a pressure that it may easily be condensed at atmospheric temperature, giving up its latent heat to the cooling medium in the process. The liquefied refrigerant then passes through a reducing valve which lowers the pressure to such a point that the liquid will vaporise at a very much lower temperature, thus taking in the latent heat required from inside the cabinet. The gas then returns to the compressor and the cycle is repeated.

From this it will be seen, without going into the mathematics of it, that for any given weight of refrigerant, latent heat of vaporisation is absorbed from the air inside the cabinet and given up to the air outside, the energy supplied to the compressor being used to keep the cycle moving.

The coefficient of performance of a refrigerator, which is the ratio of the heat removed from the cold body to the energy supplied to the compressor, may be anything up to five or more, and thus a continuously running domestic refrigerator is supplying three or four times as much heat to the room in which it is situated as is being supplied in the form of electrical energy to drive the compressor. This effect is not generally noticeable, since refrigerators are not usually run in the winter, and in summer with open windows and doors the circulation of air is too great for any appreciable heating to be achieved.

As regards Mr. Brocklebank's suggestion that it would be more efficient to utilise this energy by means of an electric radiator, one has only to consider that a thermostatically controlled refrigerator uses only about two units a day, which would allow of one "Bar" of a radiator to be used about one hour in twelve. Cold comfort!

To close with a few remarks on the economics of the subject. There is no reason at all why a heat pump should not be used for heating a building, and once installed it would supply heat at about a quarter of the cost of electrical energy, but the size of the plant would be considerable and the initial cost and cost of maintenance would be prohibitive for all normal purposes. Thus the heat pump is likely to remain one of the "Marvels of Science" such as is used by the Sunday Press to make the public believe that soon it really will be getting something for nothing.

Yours faithfully,
J. C. HARRISON,
B.Eng.

Locomotive Brake Blocks

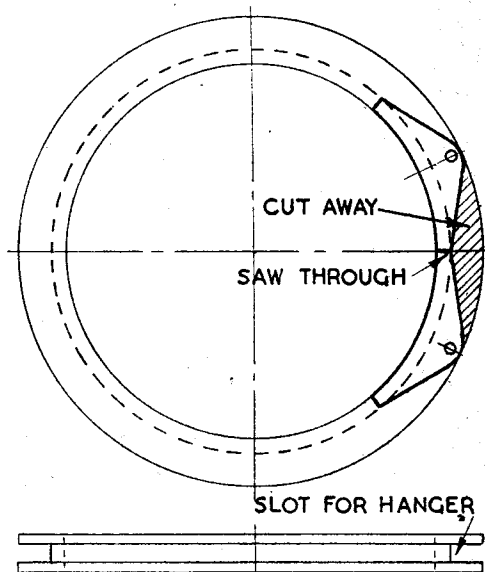
DEAR SIR,—I have just read through "L.B.S.C.'s" article on "Hielan' Lassie's" tender, on his method of making brake blocks. I thought my method of making brake blocks for a $3\frac{1}{2}$ -in. "Scot," under construction, might be useful to others of "the fraternity" with only a lathe to hand.

I picked up the end of an old brass bushing, chucked it in the lathe and bored it out to the tread diameter of wheels, and faced one side. I chucked it again in the lathe by the bore and turned it outside to breadth required, faced it to

the thickness, then ran a $\frac{1}{8}$ -in. broad parting-tool in to make the slots for hangers, then cut out each individual block.

I only required six for the "Scot"—one can get seven out of the ring.

I have just been to the local horticultural show where a friend had a finished "Scot" on show. As I made the patterns for cylinders, main frame,



cross-members, horn-blocks, etc., etc., and machined same, and had them cast in gun-metal, it did give me some encouragement to see the finished article.

Yours faithfully,
Bukuru, Nigeria. "EXILE."

Treading

DEAR SIR,—I recently acquired a lathe and a drilling machine, both of which are pedal-driven.

The lathe will be motorised in due course, but the drilling machine kept in its present state.

I have had occasion to use the lathe quite a lot and as it is a fairly hefty machine of $4\frac{1}{2}$ -in. centres, it makes pretty hard work. I remembered an old dodge which may not be known to many of your younger readers, and greatly reduces the fatigue of pedalling.

Build a small floor stand, the top of which is exactly level with the face of the treadle when the latter is in its lowest position, and stand on this when operating. It is really surprising what a great deal of difference this makes. The reason is not far to seek, one does not have to flex the knee and thigh joints nearly so much on the one hand, and the other leg momentarily straightens right out at each stroke.

The thing is so simple and cheap that no "pedal artist" should work without it. I hasten to add that the idea is not original, and unless I am mistaken has been referred to years back in these columns.

Yours faithfully,
Wealdstone. K. N. HARRIS.